

INSTITUTION NOTES

December, 1941

Institution Activities

A number of interesting lectures have been given before various Local Sections during the past few weeks, including a paper by Dr. Dudding, M.B.E. (General Electric Co. Research Dept.), to the London Section on "Sampling Inspection and Quality Control" on December 12. It is hoped to publish this paper at an early date. Amongst those who took part in the discussion on the paper were Sir Frank Gill (Chairman, Standard Telephones and Cables Ltd.), Mr. Good (Director, British Standards Institution), Mr. Rolt (Director of Gauges, Ministry of Supply), and Brigadier E. A. Woods (Chief Inspector of Armaments).

Dr. Schlesinger has given a paper on "Surface Finish" to the Coventry, Manchester, Birmingham, and other Sections, outlining the work of our Research Department on this important subject. The greatest interest has been shown in this paper. The report of the Research Department on Surface Finish is to be published next month, and a summary of the report will be published in *The Journal*.

Mr. Puckey has addressed the London Graduate Section on the work of the Technical and Publications Committee, over which he presides. The Section has arranged a series of lecture meetings for the second Saturday in each month from January to May, inclusive. Mr. R. F. Holland has just succeeded Mr. A. C. Pike as chairman of the Section.

A Yorkshire Graduate Section has been formed this month, with Mr. G. R. Parker (Graduate) as Chairman, and a Provisional Committee is being set up in Belfast to promote the formation of a Northern Ireland Section.

Subscriptions Received for Research

Since the list in last month's "Notes," the following subscriptions for the work of the Research Department have been received:—

	£	s.	d.
Albion Motors Ltd.	100	0	0
Ferranti Ltd.	52	10	0
Robey & Co. Ltd.... ..	50	0	0
Adamant Engineering Co. Ltd.... ..	26	5	0
J. E. Baty & Co.... ..	26	5	0
H. M. Hobson Components Ltd.	21	0	0
Edward Pryor & Son	20	0	0
British Northrop Loom Co. Ltd.	10	0	0
Jackson Boilers Ltd.	5	5	0
C. B. Whitaker (Member)	5	5	0
Mactaggert Scott & Co. Ltd.	5	0	0
A. H. Laycock (Int. Associate Member)	0	12	6
A. V. W. Fiddler (Graduate)	0	10	0
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	£322	12	6
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The fact that goods made of raw materials in short supply owing to war conditions are advertised in "The Journal" should not be taken as an indication that they are necessarily available for export.

HIGHER NATIONAL CERTIFICATE COURSES IN PRODUCTION ENGINEERING

BOARD OF EDUCATION

December, 1941

Notes for the Guidance of Colleges and Schools on the Arrangement of Courses for Higher National Certificates in Production Engineering under Rules 106 (P).

1. The Joint Committee of the Institution of Mechanical Engineers, the Institution of Production Engineers, and the Board of Education have thought it desirable to prepare the following notes, together with specimen syllabuses, for the general guidance of those Colleges and Schools contemplating the inauguration of Higher National Certificate courses in Production Engineering. Certain general principles, enunciated in Appendix 1, have been kept in view throughout.

2. It has been assumed that the syllabus content of the Higher National Certificate courses falls into two main parts: (i) the basic part, containing those subjects which it is reasonable to assume all production engineers should study; and (ii) the advanced part, composed of more specialised subjects from which a selection should be made. The basic work should normally be done in the first or A.1 year; and the advanced work, built upon this, would then be completed in the second or A.2 year.

3. In addition to the basic and advanced parts it is desirable to give consideration to (a) the preliminary work in Workshop Technology, a knowledge of which must be assumed if the standard of the basic course is to be sufficiently high; and (b) subjects which are best studied at a post Higher Certificate stage. With regard to (a), a fairly detailed syllabus of the more elementary work which ought to be covered before entry to the course, has been included in Appendix 2. If the subject Workshop Technology is one of those in the last year of the Ordinary National Certificate course then it is probable that this will include most of the work suggested.

THE INSTITUTION OF PRODUCTION ENGINEERS

4. **The Basic Course.** A.1 year. It is considered that the following subjects, of which suggested syllabuses are given in Appendix 3, are basic to the course.

Properties and Strength of Materials.
Metallurgy.
Theory of Machines.
Jig and Tool Design.
Machine Tools.
Metrology (Technical Measurement).

The six subjects may be grouped into three pairs which are to some extent interlinked.

This selection is not exclusive, and Colleges and Schools may be able to give good reasons for not introducing all of this basic work in the A.1 year and for the inclusion of other subjects. Clearly, if additional time during the day is available a wider course may be prepared.

5. **The Advanced Course.** A.2 year. There are many subjects that might well be included at this stage. The following are considered appropriate, and suggested syllabuses for each are given in Appendix 4.

Jig and Tool Design.	Plastic Technology.
Metrology (Technical Measurement).	Press Work—Plastics.
Machine Tools.	Welding Processes.
Metallurgy.	Hot Stamping and Forging.
Press and Sheet Metal Work.	Foundry Processes.

The grouping of the subjects is a matter for consideration but the following is suggested as a reasonable series of groups for specific branches of industry. Only one group would normally be included in the work for the A.2 year.

Group 1.	Group 4.
Jig and Tool Design.	Jig and Tool Design.
Machine Tools.	Metallurgy.
Metrology (Technical Measurement).	Welding Processes.
Group 2.	Group 5.
Jig and Tool Design.	Jig and Tool Design.
Press and Sheet Metal Work.	Metallurgy.
Welding Processes.	Hot Stamping and Forging.
Group 3.	Group 6.
Jig and Tool Design.	Jig and Tool Design.
Plastics Technology.	Metallurgy.
Press Work—Plastics.	Foundry Processes.

Subjects not included in one A.2 group may of course be taken subsequently for endorsement on the Certificate.

6. Post Higher National Certificate Subjects. The following subjects are recommended for study at a post Higher Certificate stage ; syllabuses for these are in course of preparation.

Motion and Time Study.

Electro Technology.

Specifications and Estimates.

Management subjects.

7. It is recognised that it may be appropriate for Colleges and Schools in certain areas to operate courses that are strongly biased throughout the Ordinary National Certificate stage towards Production Engineering, and that the courses suggested in the foregoing notes would in those cases require modification.

8. It is desired to emphasise the importance of including sufficient laboratory work in all courses, this involving, for example, the experimental, rather than the operational use of Machine Tools and Measuring Equipment. A memorandum on Laboratory Work will be issued later.

APPENDIX 1

General Principles applicable to Higher National Certificate Courses in Production Engineering

1. The courses should be educationally sound, i.e., they should be progressive and conceived as a whole.

2. The subject matter of the Higher Certificate course in Production Engineering should be such as to call for the same mental effort from the student as required by other Higher National Certificate courses. In other words, the currency of the Higher National Certificate should not be debased.

3. The subjects of the course in Production Engineering could not well be taken to an appropriate standard, in the time available, at the Higher National Certificate stage, unless preparatory work in them had been done in the Ordinary National Certificate course. Where this work has not been covered it will be assumed that the College or School will make special arrangements to give students the necessary grounding in fundamentals (see Appendix 2).

4. The subjects of the curricula should be such as can be studied more effectively in Colleges and Schools than in Works ; they should be such as are teachable with the laboratory and workshop equipment available in the Colleges and Schools.

5. Subjects such as the Administrative and Managerial Group which clearly require experience and a more mature mind for their comprehension should be deferred to a post Higher National Certificate stage.

6. The courses should be framed without overmuch regard to the Associate Membership Examinations of the two Institutions and to possible exemptions. If the new Higher National Certificate courses are educationally sound and acceptable to Industry, the Institutions might reconsider the question of admissions and exemptions.

7. The courses must include those subjects which are fundamental to Production Engineers of all types, and the following are regarded as essential and appropriate :—

- (a) The workshop processing and fabrication of the materials used in engineering construction, including a study of machine tools. The relative costs of alternative materials, processes and methods of fabrication.
- (b) The physical properties of materials used in engineering. (A study of these will involve some metallurgy and heat treatment.)
- (c) The science of fine measurement as the basis of interchangeability and of production.
- (d) The principles of construction of gauges, jigs, and fixtures.
- (e) Those parts of the subjects Theory of Machines and Strength of Materials which have a direct bearing on workshop operations and motion study.

8. The mathematics essential for the treatment of the foregoing subjects should be embodied in the course.

APPENDIX 2

Syllabus of Preliminary Work in Workshop Technology

The following outline syllabus, dealing with engineering materials, the principles underlying workshop methods and processes, and the construction and functions of machines, indicates the minimum that should be covered prior to entering the Higher National Certificate course.

Materials. The composition, physical properties and engineering uses of the more common metals and their alloys, such as cast iron, wrought iron, malleable iron, mild steel, medium carbon steel, copper, gunmetal, brass, phosphor-bronze, bearing metals, and light alloys.

Tool steels, carbon and high speed steels, and special tool alloys ; their suitability for different kinds of tools.

Market forms of supply and relative costs, *e.g.*, castings, forgings, drop forgings, bars, sheets, plates, rod, and wire.

Heat Treatment. The relation between heat treatment and the physical properties of plain carbon steels.

The effect of carbon. Critical temperatures. Hardening, tempering, annealing, normalising and case hardening. Types of furnaces. Temperature measurement and control. Quenching media.

Manufacturing Processes. An outline of the preparatory processes for forming materials, *e.g.*, moulding and casting; forging; drop stamping and die casting; rolling and drawing metal bars; dishing, drawing and embossing sheet metal; pressing, spinning, and extruding; brazing and soldering; welding and cutting by arc and oxy-acetylene blow-pipe flame.

Measuring, gauging, and inspection. General principles of interchangeable production and limit gauging.

B.S.I. standards. Systems of limits and fits for plain and screwed work. Tolerances, limits; clearance, interference, and transition fits. Tolerances associated with different machining operations.

Types of limit gauges. Advantages of adjustable gauges.

Measuring equipment. Construction, care and use of surface plates, straight edges, squares, micrometers (external and internal), vernier calipers and height gauges, dial gauges, rules and protractors. Basic standards of length. Imperial standard yard. International standard metre. Conversion factor. Standard and workshop end gauges; their accuracies and uses.

Cutting Tools. Cutting action of tools such as hand tools; lathe tools; drills; reamers; milling cutters; dies; taps; &c. Tool angles for different materials and purposes; measurement of tool angles. Cutting speeds and feeds. Estimation of machining times.

Machine Tools. Fundamental principles in the production of machined surfaces. Copying or forming and generating. Principal features of construction and functions of the more important general purpose machines, such as lathes; sensitive, vertical and radial drilling machines; shaping, slotting, planing, and boring machines; plain milling machines and accessories; capstan and turret lathes; grinding and lapping machines. Chatter and the use of steadies.

Lubrication. Types of lubricants. Types and uses of cutting oils and solutions. Selection and methods of application.

Safety Measures. Sources of danger and methods of protection. Types of guards and safety devices. Home Office Regulations.

Operation Planning. Planning the operation layout, and estimation of floor to floor times for simple machined parts.

APPENDIX 3

Suggested Syllabuses—Basic Course. A.1 Year

PROPERTIES AND STRENGTH OF MATERIALS.

A further study of the composition, mechanical properties, and uses of engineering materials, *e.g.*, special carbon and alloy steels; the copper-tin and copper-zinc alloys; the aluminium and magnesium alloys; bearing metals; the commoner plastic materials.

The strength of shafts and thin columns. Deflection of beams under simple loading. Combined stresses. Eccentric loads. Resilience. Suddenly applied and alternating loads. Fatigue of metals. Effects of temperature change on mechanical properties of materials.

The testing of materials by the application of forces producing tension, compression, torsion, impact, and fatigue. Proof stress. Hardness tests.

The foregoing to be linked wherever possible to problems arising in the design of machine tools, tools, jigs, and measuring appliances. Standard specifications to be referred to as necessary.

Mathematics essential to the course should be included.

METALLURGY

Iron and Steel. Brief outline of pig-iron manufacture. The different types of pig iron and their uses: Hematite, basic, foundry, cold blast. Wrought iron. Steelmaking regarded as a chemical process. Outline of crucible, Bessemer, open-hearth, and electric furnace practice. Relationship between process of manufacture and specific properties.

Metallography. Elementary consideration of the structure of metals. Crystals, grains, grain boundaries. Construction and interpretation of thermal equilibrium diagrams.

Structure of alloys; eutectics; solid solutions; intermetallic compounds—critical points in straight carbon steel.

Elementary effects of work on structure and mechanical properties.

Laboratory work should be based on the lectures and should include the preparation, polishing, and etching of specimens for microscopic work.

THEORY OF MACHINES

A study of the commoner mechanisms used on machine tools and workshop plant, *e.g.*, quick return motions; parallel motions; the toggle joint; Hooke's joint; pantagraph; power press mechanisms. Velocity and acceleration diagrams. The design of cams. Angular motion; moments of inertia; fly wheels.

The transmission of power by belt (flat and vee) and chain drive, by spur and worm gearing, and by friction clutches. Epicyclic gearing.

The theory of lubrication applied to shaft and thrust bearings. Hydraulic couplings.

Mathematics essential to the course should be included.

JIG AND TOOL DESIGN

JIGS AND FIXTURES

Design. Principles of design, construction and use of jigs and fixtures, with emphasis on simplicity, ease and quickness of operation, rigidity, durability, swarf and coolant disposal.

Typical examples of plate, channel, channel and leaf, box, box and leaf types of drilling jigs. Assembly fixtures. Simple milling fixtures, including vice with special jaws. Multi-station milling fixtures. Use of standard parts.

Location and clamping. Degrees of freedom and constraint.

The six-point location principle. Selection of locating points and surfaces for (a) first, (b) subsequent operations. Types of locating pins; fixed and sliding vee locations; jacks and supporting pins; clamping devices and their particular applications. Drill bushes: types and their applications; standardisation. Multi-clamping of components on milling fixtures, &c., with equalising bars and pins.

Manufacture. Types of constructions—cast, fabricated and welded—and their particular applications.

TOOLS

Design. The design, methods of manufacture and applications of small tools, such as drills, D bits, spade drills, core drills, reamers and taps. Roller mills, side and face mills, end mills, shell end mills, &c. Simple boring bars and methods of retaining and locking cutters.

Drawing Office procedure. Assembly and piece part drawing systems. Systems of dimensioning in relation to machining processes. Use of standard limits and fits. Tool classification and records. Alteration to drawings. Storage.

MACHINE TOOLS

Sequence and Planning. Consideration of the following machines will involve the planning of work. Typical components of medium complexity should be planned throughout all the operations necessary for their complete production and involving all types of machines. Practice is desirable in subdividing work into operations of equal time duration, as in line flow production. In addition to calculation of cutting times, students should make

accurate estimates of handling times and suitable allowances for fatigue, weight handled, and tool grinding to derive total time allowance.

Speeds and Feeds. Consideration of speeds and feeds for the following machines operating on the more common engineering materials, including the alloy steels and the light alloys, and using tool steels and special tool alloys.

Capstan and Turret Lathes. Advanced work requiring multiple tool holders, involving complex tool set-ups and work holding fixtures. Various methods of thread production, their limitations and economics.

Milling Machines. Milling operations involving attachments and work holding fixtures. Continuous milling operations. Selection of cutter diameters, influence of diameter on wear and power required for driving. Economics of slab milling compared with face milling. Compound and differential indexing.

Grinding Machines. Consideration of grinding machine design to obtain high accuracy of product. Methods of tool grinding; importance of relative positions of wheel and tool. Effects of arc of contact of wheel on temperature and the creation of hardened zones and surface cracks in alloy steels.

Cutting Tools. True values of rake and clearance; chip clearance and chip breakers. Forces acting on tool point. Power absorbed in cutting. Analysis of cutting action. Work hardening by cutting. Induced work hardness. Tool metals, H.C.S., H.S.S., and cemented carbides. Hot hardness curves. Machinability. Effect of structure. Tool durability. Calculations of tool costs.

In all the foregoing the subject matter will be treated either mathematically or graphically, as required.

METROLOGY (TECHNICAL MEASUREMENT)

Component drawings. Methods of dimensioning drawings as regards limits and tolerances; dimensioning and tolerancing of contours and tapers, angles, positions of holes, concentricity.

Design of limit gauges. The design of limit gauges to suit typical component drawings.

Materials used for gauges. Wearing properties; advantages of chromium plating, and use of hard alloys; stabilising hardened tool steel.

Manufacture of gauges. Outline of special processes used in limit gauge manufacture—spot grinding, lapping, form grinding (generation and copying processes), thread grinding, positioning of holes, production of accurate angles.

Measuring equipment. Survey of construction, care and use of better class measuring equipment, including slip gauges, end gauges, comparators, projection apparatus, tool-makers' microscopes, test indicators, dividing heads, sine-bars, spirit levels, precision squares.

Methods of testing limit gauges. Methods of testing the simpler types of limit gauges involving the use of slip gauges, comparators, optical projectors, micrometers, vernier calipers, height gauges, &c.

Machine tool alignments. Importance of accuracy in machine tools: straightness and squareness of guiding surfaces; alignment of spindles with guiding surfaces; accuracy of lead screws. Alignment tests.

APPENDIX 4

Suggested Syllabuses—Advanced Course, A.2 Year

JIG AND TOOL DESIGN

(NOTE.—*The treatment of this subject might well be related to other subjects of the group.*)

JIGS AND FIXTURES

Economics of "tooling-up." Examples of jig, fixture, and tool requirements for alternative operation layouts. Costs of "tooling-up" and their relation to quantity production.

Design. Jigs for more complex drilling and reaming operations. Combined jig and inspection fixtures. Turning fixtures; expanding and contracting registers; milling, planing, shaping, profiling, broaching, indexing, welding, and assembly fixtures. Grinding fixtures for cylindrical (external and internal) and facing work. Surface grinding fixtures for straight through and revolving table methods. The use of capacity "daylight" charts.

Locating and Clamping. Quick-acting clamping devices; the use of link, toggle, cam, eccentric, interrupted thread; air, hydraulically and electrically operated mechanisms. Distortion; methods of counter-action.

Motion study as applied to Jig and Fixture Design. Loading, manipulation, cutting, sequence of operations and motion analysis. Reduction of fatigue.

TOOLS

Form tools for turning, milling, counterboring, and other operations. Development of form tools and form relieving.

Broaches: pitch of teeth, loads, chip clearance, and tooth shapes. Boring bars and cutters for more complex boring operations.

METROLOGY (TECHNICAL MEASUREMENT)

Systems of Limits and Fits. Construction of systems of limits and fits as exemplified by British Standard System and International System for both plain and screwed work.

Component Drawings. Examination of more complicated types of component drawings exemplifying application of suitable limits and tolerances to achieve correct functioning, economic manufacture, and ready control of size during manufacture and inspection.

Design of Gauges. Design of more complicated gauges, involving positioning of holes, contours, tapers and angles, with special reference to (a) relationship between limits on components and limits on gauges, (b) simplified manufacture and testing of the gauges. The functions of check and reference gauges.

Methods of Testing Limit Gauges. Use of comparators, slip gauges, optical projectors, measuring microscopes, angle measuring appliances, roller and slip gauge methods for tapers and profiles; screw gauge testing as applied to external, internal, and screw caliper gauges; methods of testing hardness of gauges. Re-checking of limit gauges; recording systems.

British Standard Specifications for Measuring Tools. Requisite accuracies; methods of checking.

Light Waves as a standard of length.

Slip Gauges. Details of manufacture of slip gauges.

Application of light waves to the measurement of reference slip gauges, both as regards flatness of surface and length.

British standard of accuracy for slip gauges. Comparators of high sensitivity.

Temperature. International basic temperature (20° C.) for engineering measurements. The importance of temperature control during accurate measurements.

Measuring Instruments. Principles underlying successful design of measuring instruments—principle of alignment; rigidity; robustness; provision of adjustments for initial accuracy and wear; simplicity of design; avoidance of redundant sources of constraint of moving parts; provision for lubrication of moving parts.

Methods of obtaining amplification by application of optical, electrical, hydraulic and pneumatic principles as exemplified by various well-known measuring instruments.

Surface finish. Its bearing on limits and tolerances; lubrication and initial wear of surfaces; progress of efforts towards establishing a scale of surface finish; existing methods of testing.

Machine Tool alignments. Alignment tests. Methods of carrying out tests on typical machine tools.

Inspection Departments. Purposes of inspection department ; desirable qualifications of inspectors ; organisation and equipment of inspection department of typical engineering works engaged in interchangeable manufacture.

MACHINE TOOLS

Sequence and Planning. Consideration of the following machines will involve the planning of work. Typical components should be planned throughout all the operations necessary for their complete production and involving all types of machines. Practice is desirable in subdividing work into operations of equal time duration as in line flow production. In addition to calculation of cutting times, students should make accurate estimates of handling times and suitable allowances for fatigue, weight handled and tool grinding to derive total time allowance.

Speeds and Feeds. Consideration of speeds and feeds for all the following machines operating on modern alloy steels and non-ferrous alloys including the light alloys, and using tool steels and special tool alloys.

Lathes. The relieving lathe : layout of cams, tool shapes and their geometry and settings for the production of form relieved cutters.

Automatic Lathes. Consideration of types. Planning of operations and layout of tools for single and multiple spindle, radial and axial cam operated automatic lathes ; design of cams. Comparison of production times between the various types ; comparison with capstan lathes. Planning of operations involving the use of second operation attachments, with the necessary cam design. The geometry of circular form tools.

Planing, Shaping, Slotting, Drilling, and Boring Machines. Adaptations to quantity production.

Broaching Machines. Types, suitable work, work holding methods.

Milling Machines. Analysis of thrust on arbor and work piece due to spiral milling cutters. Cutting action and the forces involved in upcut and in downcut milling. Spiral milling. Interference of cutters when spiral milling ; effect of variation of helix angle, depth of groove, shape of groove and diameter of cutter. Thread milling machines and their geometric limitations. Jig boring on the milling machine.

Gear Cutting. Principles of the various methods of gear cutting and finishing. The mathematics and graphics of cutter design for

the generation of gears (spur and spiral) by shaping with racks and circular cutters and by hobbing; bevel gear planing, spiral bevel gear generation. Hobs for the production of square and splined shafts, &c. Setting calculations for gear cutting machines. Work holding methods.

Grinding Machines. Methods of grinding threads, gears, splines, and spirals; relative advantages of these methods taking account of production times and wheel costs. Centreless grinding. Honing and lapping.

Jig Boring Machines. Trigonometrical problems arising when setting out work.

Machine and Tool Design. Consideration of special features in design, adopted to ensure accuracy, ease of manipulation, and absence of vibration. Hydraulic feed mechanisms. Trends in design.

In all the foregoing the subject matter will be treated mathematically or graphically as required.

METALLURGY

Iron and Steel. Effects of common elements on carbon steel. British Standard specifications for plain carbon steels. Structure of steel ingots as cast; influence of design and section thickness on the structure of iron and steel castings. Effects of hot and cold deformation on the structure and mechanical properties of steel. Effects of alloy elements. The common alloy steels. High speed steels. Machinability of ferrous metals as affected by composition and treatment.

Non-Ferrous Metals. Further study of the uses, physical and mechanical properties of the principal non-ferrous alloys of industrial importance with special reference to standard specifications. Hot and cold working. Alloys suitable for die casting.

Heat-Treatment of Metals. General industrial pyrometry.

Normalising, annealing, quenching and tempering of plain carbon steels—effects on microstructure and mechanical properties. Case-hardening and nitriding. Temper-brittleness, mass effect, strain-ageing.

Grain growth and recrystallisation, ageing.

Heat treatment plant and equipment.

Technology. (a) Hot Stamping and Forging. Variation in procedure for different materials. Effect on physical properties and structure. Flow of metal during process. Correct and incorrect fibre direction; evidence of macro-section.

(b) Press Work. Suitability of materials. Drawing operations of varying depths and metal flow. Inter-stage annealing. Material inspection at various stages.

(c) **Welding.** The effect of electric-arc and oxy-acetylene processes on materials. Electrodes and fluxes. Structure of welds. Inspection of welds.

(d) **Extrusion.** Materials available. Type of work possible.

(e) **Bearing Metals.** Relationship between structure and duty.

Physical Considerations. Fatigue. Creep. Corrosion. Plastic properties.

Laboratory Work. The underlying aim should be to give the Production Engineer a knowledge of the causes of trouble in the working of metals and their eradication, and to distinguish between a defect in a metal and a defective method of treating or working it.

PRESS AND SHEET METAL WORK

Materials and Metallurgy. Influence of rolling and heat treatment prior to pressing, on hardness, plastic properties, accuracy of gauge, surface finish. Stretcher strain and blue brittleness in steels. Qualities of materials available and their best applications. Plasticity. Experiments in strain-hardening. Upper and lower limits of plastic range. Rates of strain-hardening. The plastic cycle. Structural changes. Influence of grain size. Ductility differences. Temperature and plasticity. Hot and cold working. Rate and uniformity of plastic working. Special considerations concerning magnesium and other light alloys; composition, age hardening, annealing, influence of ram speed in drawing operations. Sheet metal testing: Avery, Erichsen, and Olsen tests; Sach's wedge test; interpretation of results. Composition, selection, heat treatment and testing of tool metals.

Press Tools. Tool designs for blanking, piercing, raising, and drawing (single and double action), incorporating ejecting, stripping, and locating devices. Combination and follow-on tools. Reconditioning of tools. Toolmaking methods and plant. Common and special die-sinking and cutting machines and their applications. The "hobbing" process.

Shearing Operations. Progressive actions and direction of stresses in shearing. Working pressures and effects of clearance, angular shear, hardness. Development of blanks by graphical and other methods.

Bending Operations. Metal movement in bending. Bending allowances. Effect of direction of rolling on metal. "Grain," and "Temper" of rolled metal.

Expanding, Contracting, and Curling Operations. Methods of bulging, burring, flanging, beading, necking, curling, and wiring.

Drawing Operations. Metal movement and stresses in drawing. Drawing formulæ. Blank holding theory, influence of pressure, use of draw beads. Blank and shell relations, redrawing limits and methods, reverse drawing. Determination of percentage reduction to minimise necessity of annealing. Wall thickening and thinning. Ironing. Drawing rectangular and irregular shapes, determination of die lines. Drawing speed, limiting velocities. Lubricants used in drawing: composition, selection, and testing.

Cold Squeezing and Extrusion Operations. Volume changes in metal. Pressure in fluidity and rate of strain-hardening. Increasing yield points. Extrusion: suitable metals, hydraulic flow, methods, tools, and applications.

Sheet Metal Working Plant. Principles of operation. Automatic feed mechanisms. Application and maintenance of pneumatic and other die cushions. Speed and rating of presses. Automatic and other guards. Foundations: calculations for design, preparation, materials used. Plant layout.

General Note. In dealing with the foregoing sections, operation planning, comparative costs of alternative methods, the use of models, graphical computation and the use of charts should be studied at the appropriate stage.

PLASTICS TECHNOLOGY

General composition and classification of Plastics. Resinous and bituminous mouldable compositions and influence of binders and fillers on plasticity and useful properties.

Thermo-setting resinoids and mouldable compositions of the phenolic and urea types. Thermoplastics of the cellulose derivative type. Casein plastics. Vinyl and ethenoid groups of thermoplastics.

Influence of varying raw materials on the properties of plastics. Manufacture of resins and powders. Choice of fillers. Methods of controlling flow and curing time.

The choice of plastics for various purposes. Testing moulding materials and moulding for electrical and mechanical properties, and resistance to chemical and water attack.

Machining and finishing plastics.

Costs and costing.

History of the industry and modern research and development.

PRESS WORK—PLASTICS

Moulding plant and hydraulic and mechanical moulding presses. Types of mould. Moulding cycles for thermo-setting and thermoplastic materials. Injection and extrusion moulding. Manufacture of laminated sheet and tube.

Machine shop practice in finishing and machining after moulding.

Choice of type of press, mould and cycle of operations to suit material and moulding. Bending, stretching, blowing, and cementing methods of thermoplastics. Typical designs and details of moulds of the portable, fixed, multiple, semi-automatic and injection types. Design and methods of fixing inserts. Steel suitable for moulds, heat treatment, case-hardening, plating. Outline of methods of making moulds.

WELDING PROCESSES

Materials and Metallurgy. Influence of elements such as silicon, sulphur, phosphorus, nickel, chromium, molybdenum, manganese and tungsten. The effect of impurities. Grain formation, crystallisation; solid solution. Segregations of impurities and alloying elements; difference between cast and worked structures. Changes in structures due to welding. "Weld decay." The iron-carbon diagrams showing welding, forging, and annealing zones. Effects of rate of welding, and of dissolved gases. Effect of elevated temperatures; relative resistance to heat; brittle range. Refractory materials.

Welding Science. Influence of atmospheric gases during welding operations; atmospheric contamination and its avoidance. Oxidation and reduction; corrosion; scaling. Preheating and stress relieving; distortion and its avoidance. Thermit welding.

Welding procedure. Ferrous and non-ferrous metals and alloys.

Rods and Fluxes. B.S. specifications for rods; composition for gas and arc welding. Selection for different materials. Influence of rod size. Slag. The use of sand or silica in forge welding. Composition and functions of fluxes; chemical reactions.

Gas Welding. Relative advantage of fuels: oxy-acetylene, town gas, atomic hydrogen. Characteristics of the high, medium, and low pressure systems. Combustion; structure of flames; types of flames and their uses; effect of correct and incorrect flames on metals. Types of blowpipes; effects of nozzle size; gas pressure and velocity; control of velocity. Oxy-acetylene welding plant operation, care and maintenance. Relative advantages of dissolved acetylene and generated acetylene. Acetylene and oxygen manufacture; purity of gases. Applications of the process. Advantages of the various techniques; leftward; rightward; Lindewelding; vertical; overhead. Effect of two operators working together. Effect of metal thickness; of preparation; and of angles of blowpipe and rod. Flame cutting by hand and machine; flame adjustment; gas pressures. Metal spraying.

Electric Welding. Application of electricity to arc and resistance welding plants. Types of plant. D.C. and A.C. plants; operation; care and maintenance. Special considerations of electrodes and fluxes; oxidation and splutter, globule size; speed of welding. The arc; short circuits; slag control; effects of variation of arc length; effect of variation of current. Relative advantages of the various techniques; vertical (up or down) and overhead welding. Resistance welding. Types of plant and applications; spot; seam; and butt. The operating cycle; influence of pressure. Types of electrodes. Influence of work thickness; limitations of work material. Automatic welding.

Work Preparation. Requisite preparation for various types of joint; effect of preparation; common defects promoted by incorrect preparation. Preparation by hand, by gas cutting and by machining. The geometric construction of layouts and patterns. Methods of supporting work during assembly. Use of fixtures and manipulators.

Inspection and Testing. Defects in welds; faults due to manipulation of blowpipe or electrode; to electrical or gas conditions, and to material. The observation of faults during welding and subsequently. Permissible corrections. Influence of faults on strength. Workshop tests; forging down and twist tests. Physical testing of new and welded work. Interpretation of test figures. B.S. specification for tests. Examination of fractures. Macrographical and microscopic inspection; interpretation of results. Testing of filler rods and of fluxes; flow and climbing ability. Testing of fuels.

Planning and Costing. Planning of operations, (a) in the shop, (b) in situ. Considerations for small and large quantity production. Layout of shops. Influence of welded construction on design. Factors influencing costs. Costing and procedure control. Relative costs of fuels; electric supply tariffs. Costs of materials; costs of preparation; relative speeds and costs of the various methods. Comparisons between welded, riveted, and cast construction. Selection and grading of labour; training of welders. Safety measures; eye protection. Home Office regulations and memoranda.

HOT STAMPING AND FORGING

Materials. Variations in stamping and forging procedure for different materials, including steels, non-ferrous metals and alloys, and the light alloys. Microscopic and macrographic examination of materials forged under differing conditions. Effects on physical properties and structure. Metal flow under differing conditions. Material inspection.

Machines. Plant used in manufacturing forged components; friction, board and steam hammers; presses for trimming, coining and hot forming; forging machines and electrical upsetting

machines. Analysis of the designs of complex forging plant; determination of plant rating and efficiency. Foundations; calculations for design, preparation, and materials used.

Furnaces and Fuels. Types and applications. Analysis of designs. Materials used in construction. Relative advantages. Calculation of operating costs. Theory of combustion; effects of air supply; tests on the calorific value of fuels.

Dies and Tools. Design of dies and tools to suit all common types of forge plant for the production of simple and complex components in both small and large quantities. Determination of parting lines, shrinkage allowance and flash allowance. Consideration of economy of material, material flow and forging time as influenced by tool design. Manufacture; methods of manufacture including die hobbing. Materials for tools and dies. Calculated estimates of tool costs.

Methods. Operation planning, time calculations, selection of manufacturing methods and plant. Calculations of comparative costs of producing the same component by different forging methods, taking into account tool costs, volume of labour required and relative value of plant used. Various types of components and quantities should be considered. Layout of forge and stamp shops for batch and quantity production.

FOUNDRY PROCESSES

Moulding Sands. (a) Natural: Red, yellow, rock, river, and sea. Influence of size and shape of grain, quality and quantity of clay on strength, permeability, and refractoriness. Sand testing. Influence of processing on properties. Sand mixing plant. Mixtures for various classes of work. Coal dust, saw-dust, &c.

(b) Synthetic: Properties and use of silica sand. Types of bond used—clay, cement, oil, molasses, dextrine, gum, flour, &c. Applications. Costs.

Facings. Properties of plumbago, blackings, silica flour, coal dust, talc, &c. Wet and dry facings. Facings for green sand, dry sand and loam, ferrous and non-ferrous.

Moulding Technique. Preparation of mould—open sand, floor, plate and machine methods. Green sand, dry sand, skin dried and loam moulding. Examples of three-part moulding with false cores and drawbacks.

Plate patterns in wood and iron; odd sides; machine plate patterns.

Methods of gating; runners and risers; feeders and feeding; camber; methods adopted to reduce stress during cooling. Chilling.

Moulding machines: general principles of construction and operation. Costs and rates of production. Motion studies of the more common machine methods.

Cores. Free venting and easy collapse. Moulds made completely in cores. Oil sand cores. Strickled cores. Stoves and drying technique.

Permanent moulds. Examples for various metals, *e.g.*, steel into ingot moulds, centrifugally cast pipes, brasses, light alloys, &c.

Materials used for moulds and methods employed. Gravity and pressure die castings. Principles embodied in die casting machines. Rates of production and cost comparisons with other processes such as "pressings," &c.

Metallurgy. (a) Cast Iron. Grading of Pig Irons and selection for different classes of foundry work. The cupola: general design and method of operation; receiver and well types; trends in modern design. Cupola charges, mixtures and coke ratios. Cupola linings. Refractory materials used and methods of lining employed.

Composition of cast iron, and influence of constituents upon properties, such as machinability, wearing and bearing properties, strength, toughness, and fluidity.

Effect of mould material upon cooling and final properties of metal.

Engineering cast irons; alloy cast irons. Heat treatment: annealing, softening, artificial ageing. B.S. Test specifications.

(b) Malleable cast iron. Raw materials; furnaces used for whiteheart and blackheart compositions and structures as cast.

Annealing cycles and furnaces. Changes occurring during annealing. Compositions and structures after annealing. Uses. Specifications.

(c) Steel. Raw materials; furnace employed: open hearth, converter and electric furnace. Charges and methods of charging. Changes in composition during melting and refining. Fluxes: additions, compositions, effect of elements on properties. Annealing and heat treatment. Special steels; alloy steels.

(d) Brasses and bronzes. Melting furnaces and temperatures. Raw materials, fluxes, &c. Alloys in general use, *e.g.*, brass, bronze, phosphor-bronze, &c. Special features of brass foundry practice.

(e) Light alloys. Aluminium and magnesium alloys. Raw materials; melting furnaces; fluxes used; effect of furnace atmosphere, temperatures.

Layout and organisation of a foundry. Layout and organisation of (a) wood and metal pattern shops; (b) core shops; (c) ferrous and non-ferrous foundries for jobbing, batch, and mass production; (d) fettling shops.

General knowledge of essential equipment. Modern methods of sand preparation and distribution. Dust extraction. Types of conveyors and their particular uses. Special layouts for continuous casting.

THE AMERICAN SOCIETY OF TOOL ENGINEERS

and its activities in connection with the U.S. Defence Programme

(a) Report by Mr. O. W. Winter

THE work of our Emergency Defence Training Committee has been varied, but all with the object in mind of assisting the defence training programme. Originally, the Society made a survey of the shortage of skilled help in the metal working industry. This survey, as is mentioned in our preliminary report, showed a decided shortage of skilled labour and a drastic necessity for emergency training measures. On the basis of this, the Emergency Defence Training Committee was established whereby practical tool engineers could, through this committee, assist in this defence training programme.

One of our first tasks was to ascertain throughout the country in the various industrial areas where we maintain chapters just what local industries' requirements were and the adequacy of defence training measures in existence. This investigation showed both adequacy and inadequacy. Where the latter was found, steps were taken to encourage and assist the establishment of additional training facilities.

A remarkable job has been done through the country by educators, industrialists, representatives of government as well as members of our committee in setting up and making operate the greatest industrial training programme this country has yet witnessed. To-day the results of this training programme are bearing fruit.

While our various Regional Staff Members are busy continuing this assistance and technical advice, the committee is now primarily engaged in assisting in defence training on a college level, involving the general subject of tool engineering and its various ramifications.

The general subject is split up somewhat as follows:—

1. Machine Shop Practice and Cutting Tool Design.
2. Tools, Jigs, Fixture and Gauge Design and Practice.
3. Sheet Metal Work and Die Design.
4. Permanent Moulding, Plastics, and Die Casting.
5. Forging Practice and Die Design.
6. Welding Methods and Equipment.
7. Foundry Practice and Pattern Making.
8. Metallurgy and Heat-treating.
9. Manufacturing Analysis (Methods and Cost).
10. Machine Design and Applied Mechanics.

The first six subjects are considered subjects of primary importance in tool engineering, whereas the latter subjects are considered as secondary importance. By secondary importance, we mean that the tool engineer should have a general understanding of these subjects and be able to use them and be conversant with them ; however, they are not common to tool engineering alone.

At the present time, we have under way a co-operative research programme between the U.S. Office of Education, Cornell University, and the Emergency Defence Training Committee of the American Society of Tool Engineers, establishing similar training monographs to those above referred to, which by the way apply primarily to elementary machine shop training and blue print reading, &c. Unfortunately, there is a very poor selection of literature on the subject of tool engineering and particularly those six subjects of primary importance to tool engineering, and hence the preparation of our own monographs is necessary.

The first step in this work consists of reviewing all the existing material—good, bad, and mediocre and preparing subject outlines of each of the 10 subjects. The next step after this is to have a small group go to work on the actual preparation of the detailed monographs. This group will be a group from Cornell University, or possibly some other school or schools, working in direct co-operation with selected members of the Technical Sub-Committee of the Emergency Defence Training Committee. In this manner, we have a wedding, so to speak, of practical and experienced tool engineers contributing their points of view along with the college faculty experienced in the science of teaching. The combination of these two factors should result in some really fine training material. Work on this job is well under way and results should be forthcoming around the first of the year on one or more of the various sub-headings under the general subject of tool engineering.

In summation, as you can probably surmise, the work of this Society on defence training consists of finding out what is lacking in the defence training set-up and then taking steps to correct that condition if it is at all within our province to do so. Generally speaking, we have avoided becoming involved in any of the administrative functions except that in many cases, individual members of our Society are quite active in such a capacity. The general policy of the Society and the general objective of the committee is to be of assistance in a technical advisory capacity inasmuch as we feel that it is in this field that we are most needed and most competent. It also might be added that it is in this field that we are least likely to incur opposition and resentment and, on the other hand, are most likely to have our efforts and assistance appreciated. That the latter exists has been amply testified by a number of letters from the U.S. Office of Education, the Office of

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Production Management, the U.S. Department of Labour, &c. You can rest assured that to us it is a glorious opportunity to do a service to the defence programme that no other group could do, at least as well, and in this manner as a means of utilizing our spare time, what little there is left of it these days for busy tool engineers, in the general promotion of the defence programme, we feel that we are doubly doing our part in the fight for freedom.

O. W. WINTER,

National Chairman,
Emergency Defence Training Committee,
American Society of Tool Engineers.

September 18th, 1941.

(b) Proposed College Course in Tool Engineering

SUBJECT.	HOURS PER WEEK.				
	Credit Hours.	Lecture and Recitation	Labour and Lecture.	Total in School.	Preparation.
<i>First Year—First Quarter.</i>					
Chemistry—General	4 ...	3 ...	4 ...	7 ...	5
College Algebra	5 ...	5 ...	— ...	5 ...	10
English	4 ...	3 ...	— ...	3 ...	6
Hygiene and Personal Living.....	1 ...	1 ...	— ...	1 ...	2
Survey of and Introduction to Engineering	1 ...	1 ...	— ...	1 ...	2
Engineering Drawing	4 ...	1 ...	8 ...	9 ...	2
Physical Education	1 ...	— ...	2 ...	2 ...	—
Military Science	1 ...	1 ...	— ...	1 ...	—
TOTAL	21	15	14	29	27
<i>First Year—Second Quarter.</i>					
Chemistry—General (Continued)	4 ...	3 ...	4 ...	7 ...	5
Plane Trigonometry	5 ...	5 ...	— ...	5 ...	10
English	3 ...	3 ...	— ...	3 ...	6
Engineering Drawing	4 ...	1 ...	8 ...	9 ...	2
Physical Education	1 ...	— ...	2 ...	2 ...	—
Military Science	1 ...	1 ...	— ...	1 ...	—
Survey of and Introduction to Engineering	1 ...	1 ...	— ...	1 ...	2
TOTAL	19	14	14	23	25
<i>First Year—Third Quarter.</i>					
Chemistry—Qualitative Analysis	4 ...	2 ...	6 ...	8 ...	5
Analytic Geometry	5 ...	5 ...	— ...	5 ...	10
Descriptive Geometry	4 ...	— ...	8 ...	8 ...	—
English	3 ...	3 ...	— ...	3 ...	6
Elementary Surveying	3 ...	2 ...	1 ...	3 ...	4
Physical Education	1 ...	— ...	2 ...	2 ...	—
Military Science	1 ...	1 ...	— ...	1 ...	—
TOTAL	21	13	17	30	25

THE INSTITUTION OF PRODUCTION ENGINEERS

SUBJECT.	HOURS PER WEEK.				
	Credit Hours.	Lecture and Recitation.	Labour and Lecture.	Total in School.	Prepar- ation.
<i>Second Year—First Quarter.</i>					
Calculus 441	5 ...	5 ...	— ...	5 ...	10
Physics—Mechanics 431	5 ...	4 ...	2 ...	6 ...	8
Engineering Drawing 421	3 ...	1 ...	6 ...	7 ...	2
Military Science 410	1 ...	1 ...	— ...	1 ...	—
Forging, Heating, Treating, Welding 418	3 ...	— ...	7 ...	7 ...	2
Materials of Engineering... 427	3 ...	3 ...	— ...	3 ...	6
TOTAL	20	14	15	29	28
<i>Second Year—Second Quarter.</i>					
Calculus 442	5 ...	5 ...	— ...	5 ...	10
Physics—Heat, Sound, and Light 432	5 ...	4 ...	2 ...	6 ...	8
Elementary Machine Draw- ing 422	3 ...	1 ...	6 ...	7 ...	2
Military Science 411	1 ...	1 ...	— ...	1 ...	—
Foundry Practice 405	3 ...	— ...	6 ...	6 ...	2
Pattern Making 411	3 ...	— ...	6 ...	6 ...	2
TOTAL	20	11	20	31	24
<i>Second Year—Third Quarter.</i>					
Calculus 443	5 ...	5 ...	— ...	5 ...	10
Physics — Electricity and Magnetism 433	5 ...	4 ...	2 ...	6 ...	8
Principles of Metallography 606	3 ...	2 ...	4 ...	6 ...	3
Military Science 412	1 ...	1 ...	— ...	1 ...	1
Elementary Machine Shop Practice 419	3 ...	— ...	6 ...	6 ...	2
Outline of Industrial En- gineering 3	3 ...	3 ...	— ...	3 ...	6
TOTAL	20	15	12	27	30
<i>Third Year—First Quarter.</i>					
Mechanics—Statics 601	5 ...	5 ...	— ...	5 ...	10
Economics—Principles ... 403	3 ...	3 ...	— ...	3 ...	6
Advanced Machine Shop Practice 421	3 ...	— ...	6 ...	6 ...	2
Accounting—General 405	5 ...	5 ...	— ...	5 ...	10
Metallography of Iron and Steel 701	4 ...	2 ...	6 ...	8 ...	4
TOTAL	20	15	12	27	32

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HOURS PER WEEK.

SUBJECT.	Credit Hours.	Lecture and Recitation.	Labour and Lecture.	Total in School.	Preparation.
<i>Third Year—Second Quarter.</i>					
Mechanics—Dynamics	3	3	—	3	6
Economics—Principles ...	3	3	—	3	6
Cost Accounting	5	5	—	5	10
Metallography of Special Alloy Steels	3	2	3	5	4
Time and Motion Study ...	3	3	—	3	6
Time Study Practice	3	1	5	6	1
TOTAL	20	17	8	25	33

Third Year—Third Quarter.

Mechanics—Strength of Materials	5	4	2	6	9
Personnel Management	3	3	—	3	6
Metal Cutting	3	2	3	5	6
Machine Shop Operations and Equipment.....	3	3	—	3	6
Advanced Machine Design, 513	5	4	3	7	8
Inspection Trip	2	—	—	—	—
TOTAL	21	16	8	24	35

Fourth Year—First Quarter.

Electrical Engineering	4	3	3	6	6
Machine Tool Design	2	2	—	2	4
Inspection Procedure and Gaging Equipment	2	2	—	2	4
Metal Forming	2	2	—	2	4
Tool and Die Making	2	—	6	6	2
Hydraulics, Pneumatics, Elec- tronics	3	1	6	7	2
Cutting-Tool Design.....	2	1	3	4	2
Welding and Welded Structures	3	1	6	7	3
TOTAL	20	12	24	36	27

Fourth Year—Second Quarter.

Electrical Engineering	4	3	3	6	6
Jig and Fixture Design.....	5	—	15	15	4
Finishing Processes and Methods	2	2	—	2	4
The Industrial Plant	2	1	3	4	4
Wages and Compensation	2	2	—	2	4
Production Control	3	3	—	3	6
Materials Handling	2	1	3	4	2
TOTAL	20	12	24	55	30

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SUBJECT.	HOURS PER WEEK.					
	Credit Hours.	Lecture and Recitation.	Labour and Lecture.	Total in School.	Prepar- ation.	
<i>Fourth Year—Third Quarter.</i>						
Advanced English for Engineer.....	419	3 ... 3 ...	— ...	3 ...	6	
Inspection Trip	730	2 ... — ...	— ...	— ...	—	
Equipment Selection and In- vestment		2 ... 2 ...	— ...	2 ...	4	
Sheet Metal Working		3 ... 3 ...	— ...	3 ...	6	
Die Design.....		4 ... — ...	12 ...	12 ...	3	
Cost and Production Estimating		2 ... 2 ...	— ...	2 ...	4	
Budgets and Planning		2 ... 2 ...	— ...	2 ...	4	
Resistance Welding		2 ... 2 ...	— ...	2 ...	4	
Maintenance and Millwrighting		1 ... 1 ...	— ...	1 ...	2	
TOTAL		21	15	12	27	33

(c) The University of the State of New York

The State Education Department

The Bureau of Industrial and Technical Education, Albany, New York

The unit courses for beginners in Machine Shop Practice which have been prepared by the New York State Education Department for use in National Defence training classes may be secured at the following prices, f.o.b. Albany, N.Y., from: The Greenwood Company, 26, Hamilton Street, Albany, New York.

Size of Order :		1000 or over	100 to 999	25 to 99	Single Copy
		Unit Price	Unit Price	Unit Price	Unit Price
*Heat Treatment	59 sheets	.30	.35	.40	.45
*Job Series	58 sheets	.30	.35	.40	.45
*Measurement ...	73 sheets	.33	.40	.45	.50
*Drill Press	50 sheets	.27	.35	.40	.45
*Bench Work ...	96 sheets	.42	.50	.57	.65
*Blue Print Reading	101 Pages	.35	.42	.50	.55
†Lathe	170 sheets	.78	.85	1.00	1.10
†Mathematics ...	190 sheets	.83	.90	1.05	1.15

* Available now.

† Available May 15th, 1941.

Milling Machine and Shaper—Available July 1st.

AN EMERGENCY DEFENCE TRAINING PROGRAMME

Preamble

Early in 1939 it became evident to the American Society of Tool Engineers that we were facing a severe shortage of skilled men in those mechanical lines which contribute to production including both the engineering and the trade fields. This was evidenced by the fact that the demand for skilled men of various kinds exceeded the supply at a time when it was evident that industry would expand to even greater production totals.

The type of skill mostly in demand at that time in the engineering field was for tool engineers, process men, operation lay-out men, and tool, die, and machine designers. In the skilled trade field the shortage included skilled mechanics and tool and die makers, together with certain types of skilled machine operators. So far as we knew, our educational institutions were doing little toward training tool engineers although in some instances they were teaching a tool or die design course. However, more tool and die design training was being done by private schools than by our public educational institutions. Also, at that time, apprentice training of skilled mechanics and tool and die makers had reached a low ebb due to pressure of union labour restrictions and the natural reduction of such effort through the depression years. Many large organizations were continuing their apprenticeship courses, but most smaller organizations had little, if any, activity along these lines. Immigration restrictions, moreover, had reduced the formerly large scale influx of trained mechanics from Europe to a mere "trickle."

The A.S.T.E. Committee on Education was appointed for the purpose of studying the entire scope of this problem and to report their recommendations on activities which would relieve the shortage and increase training of certain engineering subjects and skilled trades for industry. They were to study and recommend educational courses and curricula if such were found necessary and to review apprentice activities and study the results of such activities as have been in effect over a long period of years. Their report was also to include recommendations as to what activities the American Society of Tool Engineers could conduct which would improve the situation or give aid to such educational institutions or industries as were trying to train skilled men for industry.

This programme was well under way when the launching of our National Defence Programme injected further elements into the situation. It readily became apparent that the shortage which we already knew existed was being aggravated by the needs for rapid industrial expansion to meet armament requirements.

To determine the extent of the shortage existing in tool engineering and skilled labour fields, the A.S.T.E. engaged on a survey of the metal working industry. This survey, due to the need of an immediate answer, was conducted on the "sampling" basis, and the answers obtained were then re-calculated by extension to the industry as a whole. While the totals thus obtained are, of course, subject to an "experimental" error, it is our belief that this error is less than the differences in industrial requirements for skilled men from month to month. In any event, the facts revealed were so startling as to the actual shortage that any experimental error was of little consequence.

The survey revealed that for then "immediate requirements," industry needed 32,600 tool engineers, 128,000 tool and die makers, and over 400,000 skilled mechanics. The extent to which this shortage was distributed was indicated by the fact that 26 per cent of metal working plants needed additional tool engineers, 52 per cent needed additional tool and die makers, and 60 per cent were experiencing a shortage of skilled mechanics.

The survey also revealed that 53 per cent of all metal working plants were definitely scheduled to have their operations expanded during the balance of the year. For these *definitely* planned expansions (expansions based on "possibilities" of defence orders were eliminated), the metal working industry indicated a need, in addition to the totals already cited, of 78,000 tool engineers, 281,000 tool and die makers, and 332,000 skilled mechanics.

The survey thus showed a shortage of :—

110,000 Tool Engineers ;
310,000 Tool and Die Makers ;
740,000 Skilled Mechanics.

A total in excess of one and one-quarter million men.

If we consider the estimated ratio wherein 10 unskilled men are required to every one skilled man in industry, the importance of quickly obtaining the required skilled men can be readily appreciated.

At the same time, the A.S.T.E. also surveyed the metal working industry to determine the extent to which industry was endeavouring to meet this problem at least part way. It was found that only 30 per cent of all metal working plants had some type of an apprentice training programme, while only an additional 11 per cent had any arrangement for training men in some way for their own particular requirements. While the percentage of plants needing additional skilled help was much smaller among those carrying on training courses, the seriousness of the situation was revealed

by the fact that even in such plants a sizeable representation of companies was unable to cope with the rapidly developing need for trained man power.

A further study of the returns from the A.S.T.E. survey also revealed that while shortages existed in practically every industrial section in the country, they differed largely as to character. Thus, in Ohio, the shortage existing in the "Skilled Mechanic" classification was far above the average (86 per cent of all plants), while less than 7 per cent of industrial plants indicated a need for Tool Engineers. In neighbouring Michigan, in contrast, over one-quarter of all plants needed Tool Engineers, while the need for Tool and Die workers was well below the average.

On the basis of its survey, the A.S.T.E. concluded that the shortage existing was so serious and its elimination so vital to the nation as a whole that, in addition to the long range educational programme under development by the Society's Educational Committee, an emergency training programme was indicated as essential. The committee was therefore instructed to proceed immediately with a study of local training on a national scale.

It is with the committee's findings in this direction that this report concerns itself.

Method of Study

Since the indicated shortage was not confined to any particular "skilled" or technical classification, the committee undertook a study of existing training plans for the following :-

1. Machine Operators.
2. Skilled Mechanics.
3. Tool and Die Makers.
4. Tool and Die Designers.
5. Tool Engineers.

The study covered training programmes in use by industrial concerns, those followed by vocational schools, and others instituted through state or federal action, including activities in this direction of the W.P.A. and N.Y.A. state supervised industrial training courses, &c.

These courses were analyzed as to their immediate usefulness as a whole to industry, nationally and locally, and as to specific details of operation which were proving particularly effective.

Primary Conclusions

1. Training of men to meet the indicated shortages falls in two classifications :—

- (a) Training of men with no experience to fit them for jobs in industry.
- (b) Training of men already in industry to advance them to more responsible occupations.

The first calls for training of such classifications as machine operators, riveters, welders, sheet metal workers generally, &c.

The second calls for "upgrading", selection and training of machine operators, &c., to secure men needed for work requiring skilled mechanics, tool and die makers, &c.; selection from and training of men in these latter classifications at present to enable them to perform the functions of tool designers and tool engineers.

2. The tremendous diversification of industrial occupations at the base of the industrial ladder, and great differences existing in local requirements as to occupation indicate that the training of men for occupations requiring the least skill can be performed most effectively under localized direction. There is no point in an emergency training programme in training men, for instance, to operate lathes in an industrial community where sheet metal workers are needed.

3. "Upgrading" education of men in industry is again a problem requiring localized direction since, in an emergency training programme, all such education must be designed to meet specific needs if time, effort, and money is not to be wasted.

4. Too much time is being wasted in setting up proper educational facilities in many communities, largely due to the fact that no one group has any authority and insufficient co-operation exists between industry, labour, schools, and "governmental" bodies to set up the needed facilities. This is particularly important, since the greatest shortage for trained men is developing in the smaller industrial businesses having no facilities or ability to meet their need for man power.

5. The already existing shortage, which promises to reach a new peak next spring, has already resulted in and bids fair to aggravate the "raiding" and cross-raiding by industrial concerns of each others' trained personnel, resulting only in an increase of labour costs and a reduction in operating efficiency due to the necessity for re-education of men in their new jobs.

6. Needed in each industrial community is a group with what amounts to administrative force. In this group industry, government (municipal, state, &c.), and educational facilities must have a voice.

7. To achieve the needed co-operation between industry, labour, government, and education, it appears advisable to set up a national chain of local co-ordinating committees acting in a purely advisory manner. In this work, the American Society of Tool Engineers, as a purely technical organization acquainted with current needs, can be a major service to the hundreds of industrial communities in and near which the Society maintains Chapters.

8. A national advisory committee should also be organized to provide a needed interchange of information between the various local committees to assist these in increasing the effectiveness of their activities.

9. Recognition of the seriousness of the situation should be brought home to the general population in each industrial community, to the end that the community will wholeheartedly support and prevent delays in and sabotage of training work.

Training of Machine Operators

The training of machine operators is the first problem to be met, not only to meet the existing shortage of specific types of work but also to permit the advancement of already available "machine operators" to work requiring greater skill.

(NOTE.—The term "machine operator" is here used to designate not only operators of machine tools but also all other occupations requiring knowledge and training only in one specific direction—such as riveters, welders, filers, &c.)

In many communities co-operative training programmes to supply men capable of performing specific manufacturing operations have been in operation for some time. Study of such courses, therefore, permits the making of definite recommendations as to training procedure.

Recommended Procedure

LENGTH OF SCHOOL TRAINING PERIOD.—Approximately 4 weeks.

SCHOOL CURRICULUM.—First week: 34 hours of class-room work, to give trainees a quick review of shop arithmetic, including angle measurement; applied science such as power, heat, friction, lubrication, coolants, safety, and hygiene; blue print reading; operation sheet analysis, and the use of measuring instruments.

Second, third, and fourth weeks : concentrated shop work on a *single* machine tool. The type of machine on which a man will be trained is largely governed by his grasp and intelligence as regarding things mechanical, as shown by his grades and his expressed interest during the classroom period.

Best men are trained on grinding machines, followed by milling machines, boring mills, lathes, and drill press operations, in order.

NUMBER OF TRAINEES.—Number of men to be trained on each type of operation is governed by the indicated requirements of industry in the specific locality.

TRAINING WITHIN INDUSTRY.—Following completion of school curriculum, trainees should enter plant, acting first as an observer beside the regular operator, gradually working into the job of running the machine on his own. The period required takes anywhere from two to six weeks, depending upon the type of work and the trainee's aptitude. During this time, additional study should be followed on suitable subjects in afternoon or evening classes, depending upon whether the individual is working on a day or night shift.

SCHOOL FACULTY.—Since the trainees are to occupy specific positions in specific industries, instructors should be drawn from such industries themselves, since they are best acquainted with the problems involved.

Instructors should be selected from among the best qualified men in industrial plants. They are given a short course (experience indicates that about 30 hours suffices) in "teaching" prior to being placed on the faculty. Payment of such instructors should be on an hourly basis commensurate with or slightly higher than what they would earn at the plant, recognizing that this is extra-hour work and taking into account group bonus and overtime allowance. Where possible this compensation should come from federal funds. If such funds are not available, local plants should provide for same. Payment of a nominal salary by the plant from which they are drawn is recommended to maintain contact between the operator and the plant.

SCHOOL EQUIPMENT.—Machine tools, &c., needed for school work may be drawn in most cases from "surplus" equipment available in industrial plants in the community. Local plants can assist in the re-building or re-conditioning of such equipment.

SUPPLIES.—Local plants can and should furnish miscellaneous supplies, such as bar ends, scrap forgings, castings, &c., that can be worked on by the trainees in school classes.

SCHOOL SUPERVISION.—Schools should be under the direct supervision of men selected for the job by the advisory committee and preferably should be educational authorities. Such men will work closely with industries and the advisory committee to adjust procedure in line with indicated requirements changing needs, particularly as to the effectiveness with which the trainees are fitting into industrial occupations.

BUILDINGS.—Buildings for such schools should be provided from existing educational facilities in the community through the co-operation of educational boards.

FINANCING.—Financing of such schools should be secured, if possible, through the co-operation of municipal, county, or state governmental bodies. Action in this direction has already been taken by a number of states, including Connecticut and New York. Federal funds are available through State Boards of Education.

SELECTION OF TRAINEES.—Since trainees are to occupy specific jobs in industry, their selection will best be governed through the personnel departments of industrial concerns or committees consisting of qualified personnel men. This should apply whether trainees are employed at present or not. Aptitude and performance tests have been found useful in the selection of trainees, as well as the recommendation of the present employer where such exists. In some cases it may be desirable to employ trainees for a few hours a day and let them spend the balance of the time in school. This may depend upon regulations established to cover the use of federal funds.

Upgrading Education

The problem involved in quickly obtaining men for industrial occupations requiring higher degrees of skill or technical knowledge can best be met by individual action in each specific manufacturing organization.

In each plant an immediate study should be made of all employees with a view to selecting those suited for occupations requiring higher degrees of skill than those they are at present performing.

Where such studies have been made, industrial concerns have been surprised to discover how many of their operators could quickly be trained to occupy positions of greater skill. In many cases but little training has been found necessary to adapt a trained and capable machine operator to jobs requiring the abilities of a skilled mechanic. A really skilled mechanic can be converted quickly into a tool and die maker, and an ambitious tool and die maker can be trained without difficulty to handle simple tool and die or fixture designs.

Tool designers can be trained for lay-out, operation sheet work, and a variety of items of production planning, thus using a regular progression of training and advancement of production processing. Following are steps recommended in developing tool designers :—

1. Check over all toolmakers, foremen, assistant foremen, experimental mechanics, any college men working in shop or office, and apprentices in their last year, to see who had studied mechanical drawing, tool or machine design, mathematics, and related subjects.

2. Classify these men according to education and practical experience.

3. Divide them into groups of from three to six and assign each group to a first-class man who would be responsible for a type of work which he and his group were most familiar with.

This man should not only assist in making the drawings but should also check the work, which would allow him to call attention to errors in design and drafting technique.

Each group should be kept on similar work for some time, if possible, so that each man may be able to independently carry on in a minimum of time. If there was not sufficient similar work to keep a group on it, it would be advisable to try to make specialists of these men.

Tool engineers, in turn, can be derived from tool and die designers of considerable experience or who have gone through the various steps of design training and experience.

Schools

In large industrial communities, particularly where a large number of small industries are located, it will prove desirable to establish educational facilities outside of industry itself for upgrading training. The set-up is partially outlined above under the heading for trained machine operators. Valuable related subjects can be given that will enhance and speed up the upgrading training process.

Instructors would be drawn from tool engineers in industry and given a short course in "teaching." Such schools should preferably be operated on a basis of only a few hours of instruction to trainees daily, permitting both instructors and trainees to continue with their regular work without interruption in industrial plants. Courses would largely be confined to lectures on fundamentals of the various phases of tool engineering work and machine shop work, with examples as to their application in actual practice, derived from relatively current work available to the instructors in their own plants.

Recommendations as to Function of the American Society of Tool Engineers

1. In each Chapter town a Chapter Emergency Training Committee should be set up, composed of Tool Engineers best qualified to advise on the requirements of industry.
2. In addition to the National Educational Committee, an Emergency Defence Training Committee should be set up to handle the phase of Tool Engineering education dealing with defence training. The committee should be composed of representatives from each chapter and regional staff members in each state involved in the defence programme involving Tool Engineering work. In addition to this, there should be members in communities where no chapter exists to work with the regional staff members. This committee will co-operate with the National Educational Committee and pass on any information and data that would be of value to the work of the Educational Committee.
3. It would be the function of the Emergency Defence Committee to determine the requirements for skilled men to the extent of current training activity and to foster and promote such additional training activities as are found necessary to meet various local situations. Subsequent to this, it would continue to function in a technical advisory capacity.
4. The functions of the Regional Staff Member of the Emergency Defence Committee is to work with State Boards of Education to secure their co-operation and to co-operate and co-ordinate with the various chapter members and at large community members of the Emergency Defence Training Committee.
5. It would be the function of the Emergency Defence Training Committee, also, to assist local committees where required, in advisory conferences with industrial, governmental, and educational representatives with a view to organizing training programmes.
6. This report should be distributed in each community by the local representative of the Emergency Defence Training Committee to industries, educational boards, governmental bodies, &c.
7. Subsequent to the above, proper and thorough preliminary investigation should be made as to general character of the extent and adequacy of current defence training programmes, if such exists.
8. If there is a suspicion of inadequacy, local industry should be surveyed to determine what its requirements are.

THE INSTITUTION OF PRODUCTION ENGINEERS

9. Subsequent to such surveys, conferences should be held between industry, schools, and representatives of the Emergency Defence Training Committee to organize an adequate plan of training of the community involved.
10. Reports of all surveys, preliminary and otherwise, conferences, opinions, and attitudes divulged should be reported to the Chairman of the Emergency Defence Training Committee so that there can be a clearing house of information, data, and suggestions, so that all districts involved and affected can profit by the others' experiences.

Omitted from these recommendations, of course, are functions of the various committees in connection with the setting up of long range educational programmes in their communities. These will be the subject of a further report.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

ANNEALING, CASEHARDENING, TEMPERING.

The Tocco Process for Hardening Steel Surfaces. (*Engineering*, November 29, 1940, Vol. 150, No. 3907, p. 426, 5 figs.).

The Tocco process resembles the flame-hardening process somewhat, with the exception that the local heating of the steel surface, prior to water quenching, is effected by high-frequency induction. Briefly, the process, which was originally developed for the hardening of the crankpins and journals of crankshafts, consists in passing a heavy low-voltage current, at a frequency of 2,000 cycles per second, through heating elements, termed inductor blocks, which surround the journal to be hardened without actually touching it. The process has been developed by the Ohio Crankshaft Co., Cleveland, Ohio, U.S.A. Experimental apparatus and main hardening plant. Treated motor-car engine cam. Hardened axle shaft.

Heat-treating Troubles and their Correction, by R. B. Seger. (*The Machinist*, December 21, 1940, Vol. 84, No. 44, p. 837).

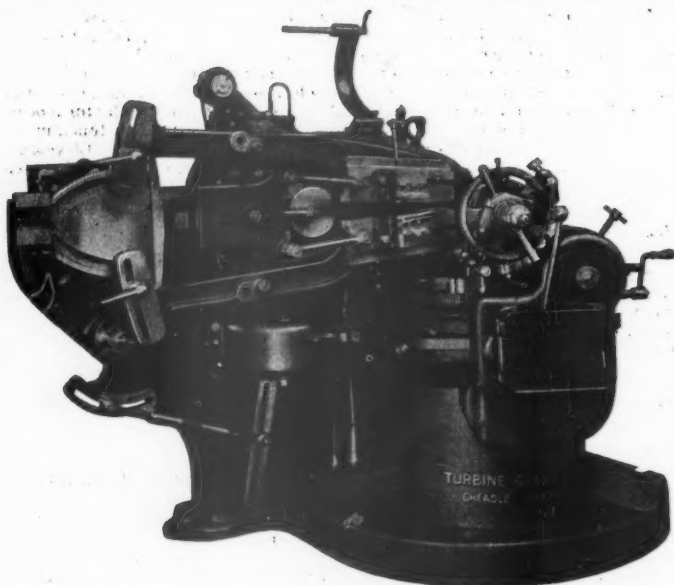
Cracking. Methods of correction. Cause. Design. Always allow as liberal a fillet as possible in corners. Underheating, non-uniform and too rapid heating. Non-uniform quench. Grain growth. Soft spots. Failure to relieve hardening strains. Cold deformation. Warpage (shape change). Cause. Mill scale. Design : Avoid the combination of light and heavy sections. Surface conditions. Gas pockets. Overheating. Machining strains. Soft spots. Cause : Quenching media. Bath temperature. Insufficient agitation. Scale. Tongs. Dirty compound. Size change (growth or shrinkage). Cause : Heating. Depth of hardness. Excessive scaling. Quenching. Cold-drawn stock. Nitriding. Spalling. Cause : Carbide network. Grinding.

COMBUSTION FURNACES.

Heat-treating for Defence. (*The Machinist*, December 14, 1940, Vol. 84, No. 43, p. 809, 30 figs.).

Electric furnace. Pots. Salt baths. The car bottom type recirculated air furnace. Gleason quenching presses to prevent distortion. Rotary furnace. Conveyor-type, electrically heated hardening furnaces. Oil-fired rotary hearth furnaces. Gas-fired continuous roller hearth furnace, especially suited for annealing brass, copper and nickel silver drawn shells and stampings at temperatures from 600 to 1400°F. Heating in contact with ammonia gas in semi-continuous nitriding furnace. Heating and quenching formed aluminium parts. Car-bottom type furnaces. The Hayes controlled-atmosphere electric furnace. The pusher-type continuous furnace. Aircraft engine cylinder forgings are nitrided in electric furnaces. Standard rotary gas carburising machines are used for annealing brass cartridge cases. The Mahr car-bottom type furnace. Rotary hearth furnaces for heating blanks for steel shells. Carburising furnaces in the heat-treatment of alloy-steel parts. Lindberg electric furnace for relieving pipe-wall stresses after bending long sections of large diameter pipe. The largest recirculated air type furnaces are 48 ft. wide, 56 ft. long, and 29 ft. high.

BEVEL GEAR GENERATOR



This machine, which is manufactured at our Cheadle Heath works, is becoming increasingly popular due to the simplicity and cheapness of the cutting tools and the wide range of work which can be handled. It is easy to set up, quick in operation, and entirely automatic. A smaller machine is now made for up to 6 in. pitch circle diameter.

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PRODUCTION ENGINEERING ABSTRACTS

COOLANT, LUBRICANT.

Filtration, by T. C. Worth. (*Automobile Engineer*, November, 1940, Vol. XXX, No. 404, p. 359, 16 figs.).

Sources of crankcase oil contamination. Analysis of used crankcase oil after 12,000 miles. Oil-conditioning methods. Gravitation. Straining. Absorption. Colour of used oil and chemical treatment. Location of cleaning unit. Batch filtration. Condition of used oil.

Improvements in Cutting Oils. (A. Q. Arend, *Chem. and Ind.*, Vol. 59, No. 46, November 16, 1940, p. 771).

The introduction of sulphur to cutting oils produced a marked change, as almost any class of steels or alloy steels could be machined at any desired speed, and thus obviated the need for making frequent changes of the liquid medium. When properly compounded, the property of oiliness is sometimes even greater than that of pure lard oil, and the increased film strength is thought to be due to the affinity which sulphur in combination with oil has for metals.

After making analysis of a number of sulphurised oils it was found that the total sulphur content seldom exceeded 2%, but with others of a much richer type a certain sulphurous corrosion appeared on the metal, which with the cutting edges of fine tools is apt to be serious.

One method of testing whether one type of cutting oil is better than another is to take observations of the kind of chips removed by the tool, and lengthy curling chips which bear heavily on the tool suggest the need for a heavily compounded sulphurised oil, while chips which break off hard indicate that a plain compounded oil, or at least lightly sulphurised oil, will suit the purpose best. Successful production of cutting oils very largely depends upon co-operation between the engineer and the oil-manufacturing firm, so that all features of working at the greatest speeds will be given every consideration at the present time. ((Communicated by D.S.R., Ministry of Aircraft Production.)

EMPLOYEES, WORKMEN, APPRENTICES.

Apprentice Wage Rates, by O. L. Harvey. (*Personnel*, November, 1940, Vol. 17, No. 2, p. 108).

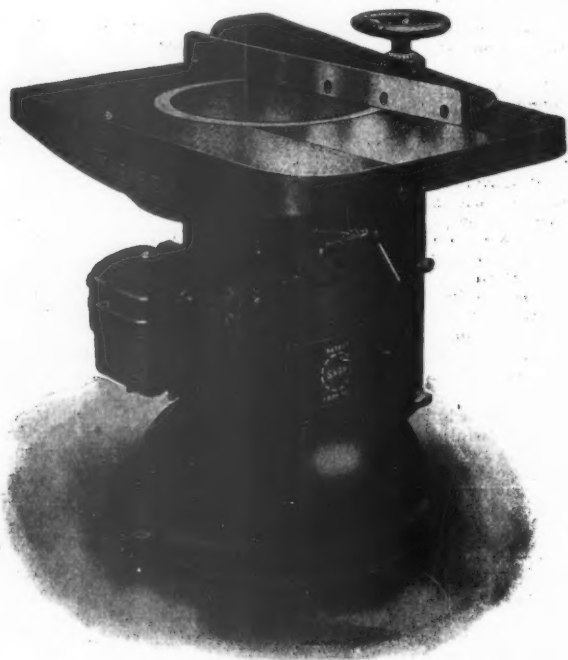
While the apprentice is first a learner, he is also an employee. On what basis then is he to be compensated? The Fair Labour Standards Act, of course, sets a lower limit on paying apprentices, but beyond that what are the best methods of compensation? In this, one of a series of articles on apprenticeship by different specialists, certain principles for guidance are outlined and then the wage and incentive plans, that are commonly used, are reviewed.

FOUNDRY, MOULDING.

Cylinder Blocks. (*Automobile Engineer*, November 14, 1940, Vol. XXX, No. 403, p. 341, 13 figs.).

A survey of the foundry organisations and methods at Morris Motors, Ltd. Sand-testing laboratory. Rotoil mixing machines. General arrangement of foundry. Large core-making machines and steel belt conveyor. Loading end of large Acme core stove. Core examination and sub-assembly of main jacket for six-cylinder block. Pendulum conveyor loading station. Mould box for six-cylinder block. Two stages of cylinder block mould assembly. Completed mould as embryo for six-cylinder block. Loop mould conveyor at pouring station. Fetting and shot-blasting department. Six-cylinder block at final foundry examination.

Snow Table Surface Grinder (patented)



THIS Table Surface Grinder enables flat surfaces to be ground by hand, without skill and in perfect safety. Many jobs now being laboriously filed or ground on the ordinary wheel by hand in a very unsatisfactory manner, may be surfaced on this machine much more accurately, and in considerably less time. A flat surface is obtained by merely passing the work across the table. The Driving Motor is incorporated in the machine. Made in two sizes, with 14 in. and 20 in. diameter grinding wheel.

Full particulars and prices

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GEARING.

Gear Finishing. (*The Tool Engineer (U.S.A.)*, December, 1940, Vol. IX, No. 8, p. 41, 34 figs.).

I. Shaving and lapping gears, by Charles R. Staub and Martin R. Anderson. Principle of operation. Rack type of gear finisher. General design of rack blade. Rotary shaving. The development of crossed axis shaving has increased uniformity and diminished noise of gears. An important advantage of shaving is economy; tool cost per gear is only 0.3d. with rack method. Effect of axial feed. Lapping is a refining process for giving gear teeth a smooth finish. Long lapping cycles should be avoided. Three-spindle lapping machine. Close-up of lap heads. Lapping a large Herringbone gear.

II. Production of gears by shaving and lapping methods, by Otto H. Schafer. Crossed axes shaving produces smooth finish. Precision is built into the gear machine and only careful, not skilled, operation is required. Causes and remedies. Mass production of quiet gears is a reality. Shoulder gears. Three conditions of quality: (1) Slight misalignment in assembly will cause excessive pressure at the ends of the teeth; (2) heat treat distortion of carburised gears causes the helical teeth to unwind; (3) heat treat distortion of carburised gears causes the teeth to thicken near the bottom and to become thinner at the top. Lapping reduces gear noise and lengthens gear life.

III. Grinding process of finishing gears, by I. J. Gruenberg. Savings in grinding. (1) Heat treatment simplified by elimination of special precautions. (2) It is not necessary to use special non-deforming steels. (3) It is not necessary to hob or cut the gear teeth to great accuracy. The finishing cut is entirely eliminated. (4) Considerable time saved in final assembly. All ground gears of a set are strictly interchangeable. Accuracy factors. Arbor mounting. Preparation for grinding.

IV. Production of gears by grinding process, by Charles Pfeffer. Limitations on design. Materials. Generating and form grinding. Combination methods. Accuracy factors.

Mechanical Gearing for Large Power Transmission, by L. M. Douglas. *Power Transmission*, December 15, 1940, Vol. 9, No. 107, p. 478, 5 figs.).

Gears may be divided into two functional classes, "high-speed" and "low-speed gears." Low-speed gears maintain a film of lubricating oil between the inter-engaging teeth, whereas the lubrication of high-speed gears is of the "greasy friction" type. The load-carrying capacity of high-speed gears is many times that of the low-speed type, and its frictional resistance is negligible in comparison. Recently, with aeroplane engine drives, gear teeth are made of very hard material with extreme accuracy, and are usually used with an "extreme pressure" lubricant. The gears of S. S. Vespian in 1909-1910 were double helical and transmitted 1,095 h.p. from 1,450 to 73 r.p.m., and had a load of 390 lb. per in. face on a 5 in. pinion—78 D. Better distribution of the load across the width of the gears. Some of these devices were: Floating frame for the pinion bearings, spring-supported bearings, multiple helical gears with load-equalising means, driving the pinion from the middle or from each end or from the middle of each helix (to reduce torsional deflection), the nodal drive, quill shaft drives, parallel drives (one pinion driving two or more wheels), differential gears, various methods of making the teeth more flexible, including laminated gears, allowances in cutting or assembly for the deflection under load. Gears capable of silent operation. The principal requirements for fully satisfactory operation are (a) sound design, construction and proper assembly; (b) satisfactory materials; (c) accuracy; (d) effective lubrication; (e) balanced parts. These items are handled in detail.

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WITH this one machine a wide variety of standard sharpening operations can be performed. In addition, several specialized grinding operations can be handled with greater speed and economy than formerly, yet with no sacrifice of accuracy. Following of spiral leads, indexing, diameter size, blade profile, feed to wheel on tooth face grinding, diameter cutting clearance, relief clearance, wheel dressing, radial faces on high spirals, all these important sharpening factors are under positive mechanical control, and all mechanical movements of the machine can be duplicated to assure uniformity of work on any number of pieces. The machine is equally adaptable for sharpening hobs, all makes of reamers, and milling cutters. For details write to

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HEATING AND VENTILATION.

Heating and Ventilation in Air Raid Shelters. (*The Heating and Ventilating Engineer, December, 1940, Vol. XIV, No. 162, p. 232.*)

Horder Committee's recommendations. Simple instructions should be posted in every shelter, covering ventilation, proper usage personal behaviour and cleanliness in order to evoke a sense of personal and corporate responsibility from every individual. Wherever possible 50 cub. ft. per person for naturally ventilated shelters might be followed until the present position of overcrowding is eased. Wherever possible the men's closets should be placed outside the shelter proper. The two questions of ventilation and heating are closely inter-related. Ventilation by natural means must be assumed. There are objections to heating the majority of shelters during their occupancy which outweigh the advantages. In regard to the problem of heating each shelter must be dealt with on its merits. Air-borne infection. The type of spray will vary from mechanically-operated to hand-operated apparatus according to the type and size of the shelter. The diphtheria toxoid necessary for protective inoculation be supplied free to the local authorities by the Ministry of Health. Position in Surrey. Main concern in Kent school shelters seems to be dampness. Real improvement could be obtained only through some means of heating. Expert knowledge needed.

Healthy Heating Systems for War-time Workers, by Andrew Westhill. (*The Factory Manager, December, 1940, Vol. VIII, No. 12, p. 675, 3 figs.*)

Many factories and extensions have had to be rather hastily put up to meet war-production needs. Some of these are in isolated or semi-isolated rural locations, where the incorporation of a central heating system may not be convenient. Overhead radiant gas heaters have solved a factory's heating problem. In addition to overhead heaters, wall pattern heaters are also in service in the same factory. Coke-burning stoves solve a Midland factory's heating problem.

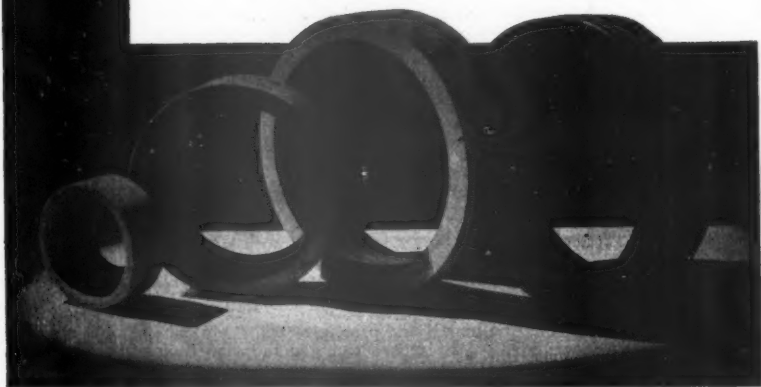
KINEMATICS.

Quick-acting Release Latches, by C. Thumim. (*Mechanical World, December 20, 1940, Vol. CVIII, No. 2816, p. 449, 10 figs.*)

An examination of the underlying principles and the means of obtaining satisfactory functioning. All latches can generally be divided into four classes: (1) dead centre; (2) overcentre toggle; (3) overcentre surface; (4) magnet. Dead-centre latch types: (a) prop rolled latch; (b) hook roller latch; (c) sliding latch. Over centre toggle latches: (a) compression toggle latch; (b) tension toggle latch. Overcentre surface latches: (a) prop type; (b) hook type; (c) roller type. Magnetic latch: (a) simple magnetic latch; (b) flux shifting latch; (c) flux lines of; (b) closed; (d) flux lines of (b) tripped. Latches under ideal conditions, no friction and no locking torque: (a) Class 1; (b) Class 2; (c) Class 3. Latch comparison for equal trip distance, no friction: Classes 1, 2 and 3. Latch comparison under normal conditions. Coefficient of friction=0.25: Classes 1, 2 and 3. Latches as force-reduction linkages: (a) Class 2 toggle on friction dead-centre; (b) Class 2 toggle with effective reduction; (c) Class 3 sliding latch reduction; (d) Class 3 roller latch reduction. Double-reduction latches: (a) correct arrangement of double-reduction latch; (b) incorrect arrangement of super-imposed latches. Latch used to supply tripping force.

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MACHINERY, MACHINE-TOOLS.

Automatic Step-drilling of Deep Holes. (*Engineering*, December 6, 1940, Vol. 150, No. 3908, p. 445, 8 figs.).

Deep holes are very difficult to produce with ordinary drilling machines, as the swarf cannot be got away without frequent reversal of the drill. Leland-Clifford Company, Worcester, Massachusetts, U.S.A., have developed ingenious machines which advance the drill rapidly to the work, drill to a predetermined depth, and then rapidly withdraw the drill for clearance of the swarf. These operations being repeated in successive stages until the desired depth of hole has been reached; the whole of the movements are automatic. Eight illustrations show duplex, fan and the spindle machine single and built in a crankshaft assembly in motor car works. The drill used for step-drilling is a two-grooved twist drill and, provided the hole is not too deep, an ordinary stock drill is suitable. With deep holes, however, drills longer than the stock sizes are required, though the fluting is not carried relatively so far in order to obtain the maximum stiffness. The unfluted portion of the shank should be slightly smaller in diameter than the cutting part.

MACHINING WITHOUT CHIP REMOVAL.

The Working of Carbon Sheet Steel. (*The Machinist*, December 14, 1940, Vol. 84, No. 43, p. 825, 24 figs.).

Type of steel used. Annealing practices. Classification by size of flat-rolled steel. U.S. standard gauge for sheet steel. Typical compositions for some higher grade sheets. Properties effected by treatment. Types of sheet steel. Approximate physical properties of cold-rolled stock. Metallic coatings. Methods in common use for cleaning and pickling. Non-metallic coatings. Typical baths for electroplating carbon sheet steel. Polishing and buffing. Welding. Cold-working and machining. Bending and shearing. Composition and heat-treatment of tools for cold-working carbon steel. Drilling and tapping. Sawing.

MANUFACTURING METHODS.

Line Production of Machine Tools, by O. Rendell. (*Machins Shop Magazine*, December, 1940, Vol. 1, No. 12, p. 60, 12 figs.).

Line erection speeded the output of small boring mills. Line production was made possible by splitting the machines into units, interchangeable between one size of machine to another; eliminating the variable time factor of hand work by more accurate machine finishing; using special machine-tools in the line to reduce hand work and by-passing units for special orders so that they do not obstruct the line flow.

Steam Turbine Blading, by R. C. Allen. (*Transactions of the A.S.M.E.*, November, 1940, Vol. 62, No. 8, p. 689, 35 figs.).

This paper reviews the blading-design practice associated with modern high-pressure high-temperature steam turbines. The design problems encountered in the development of partial-admission impulse blading to topping units are described, as well as the current engineering practice employed in the manufacture of such blading. The stress analysis used in the construction of full-admission blading is reviewed. The design procedure adopted for high-tip-speed last-row blading and the natural limits in capacity imposed on 3,600-r.p.m. turbine blading are considered, as well as the metallurgical problems associated with the fabrication and welding of the high-grade alloy steels now available.

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PRODUCTION ENGINEERING ABSTRACTS

The Airspeed Oxford, by Wilfred E. Goff. (*Aircraft Production*, December, 1940, Vol. II, No. 12, p. 383, 24 figs.).

Part III. The fuselage assembly is described and provides a further example of the extensive use made of the sub-assembly principle in building the "Oxford." The work of one of the sub-contractors in producing the cabin enclosure is reviewed in detail. Some of the metal units of the aircraft are dealt with, and the general sequence of the final assembly with the installation of equipment is also described.

MATERIALS, MATERIAL TESTING.

Modern Aircraft Materials and their Testing, by K. R. Jackman, J.S.A.E. (Vol. 47, No. 5, November, 1940, p.461) (U.S.A.)

From a quick glance at some of the newer aircraft materials and test procedures we find that the high-tensile aluminium alloys still hold the structural field, although crowded a little by some of the magnesium alloys. The alloys of beryllium hold only minor structural promise, but the pure beryllium metal may have a future for armour-plate in planes. Chrome-molybdenum steel maintains its favoured position, but it has lost some ground to the stainless steels, especially of the heat-treatable "M.286" variety. Plastic and wood-and-plastic construction probably will not immediately replace light metal construction. Thermo-plastic windows with their weight-savings, are edging out those of laminated glass, but should be tested carefully for pressurised cabin uses.

The pre-stretching of aluminium alloy stiffeners offers a method of gaining strength at no cost in weight or price. Pre-compressing, theoretically of great promise, runs into practical shop difficulties on application.

The electric resistance strain gauge of the Celstrain or Baldwin-Southwark type promises to add new impetus to practical full-scale testing and research at one-tenth of the instrumentation cost of former remote-recording extensometers. (Communicated by D.S.R., Ministry of Aircraft Production).

Magnesium in Aircraft, by N. E. Woldman. (*Metals and Alloys*, October, 1940, Vol. 12, No. 4, p. 430).

Properties of Mg-base alloys; castings, and some of their characteristic uses; forging and wrought alloys; corrosion of Mg alloys and its prevention; list of applications of Mg alloys in aircraft. (Communicated by the *Bulletin of British Non-ferrous Metals*, R. A.).

Neoprene News, No. 10, December, 1940.

Neoprene resists well to hot hydrochloric acid. After four weeks the rubber showed a 26% increase in volume, while the neoprene had only increased in volume to the extent of 9%, therefore it can be used excellently instead of rubber linings. Neoprene-lined crystallising pan; the interlocking mixing blades are covered with soft neoprene. A neoprene-lined vat; the agitator also is neoprene covered. Neoprene coated transmission belting. This belt drives a rotary gas-fired drier in a chemical works. Heat and fumes make conditions severe. Neoprene stoppers and neoprene tubing are in contact with glycerine at 284°F. A neoprene-covered fan has withstood twelve months' continuous service in hot acid fumes. Flexible ebonite vessels, funnels and pipe fittings are shock-proof. Protective clothing for chemical works; apron and gloves are of neoprene.

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The Speed Indicating Dial, Self-indexing

Hexagon Turret, Six-feed, Two-lever Gear Box, Speed Change Indicator, and many unique features make this lathe a glutton for production work—which is why it is selling, not singly, but in batches. For a full description of its many unique features of design and construction, write for publication PD 9.

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PRODUCTION ENGINEERING ABSTRACTS

MEASURING METHODS, APPARATUS.

The Basic Principles of Workshop Measurement, by James F. Driver. (*Machinery Lloyd*, December 28, 1940, Vol. XII, No. 26, p. 23, 15 figs.).

Measuring machines. Limit gauges. Screw gauges. The basic principles of workshop measurement are then concentrated in 15 clear captions.

MECHANICS, MATHEMATICS.

A Selection of Ideas for Solving Development Problems, by W. Cookson (*Sheet Metal Industries*, December, 1940, Vol. 14, No. 164, p. 1312, 5 figs.).

The setting-out required for an air-duct connection piece or shoe, fitting off-centre on to a round main. Shoe fitted to conical connecting piece. Petrol measure top. Elliptical hood twisted to outlet pipe. Rectangular transition bend.

PSYCHOLOGICAL INVESTIGATION.

An Experiment in Group Training for Prospective Foremen, by Lyle R. Mercer. (*Personnel*, November, 1940, Vol. 17, No. 2, p. 89).

The primary objective was to train a group of workmen in the problems of industrial foremanship. The experimental programme used was devised by the Extension Division of the Pennsylvania State College and presented to the "Aluminium Company of America" for a trial. Process of selection. Four tests were used in the selection: (1) a test of mental ability, an intelligence test; (2) a test for mechanical aptitude; (3) a test of emotional stability; (4) Strong vocational interest, scored for production manager. Placement test given by College representatives. Weighing of test factors. Interviews omitted from selection procedure. Outline of course. How the men were ranked. Group's reaction to training class. Results of the programme. Further training planned.

SHOP MANAGEMENT.

Merit Rating of Supervisors, Foremen and Department Heads, by Asa S. Knowles. (*Personnel*, November, 1940, Vol. 17, No. 2, p. 117).

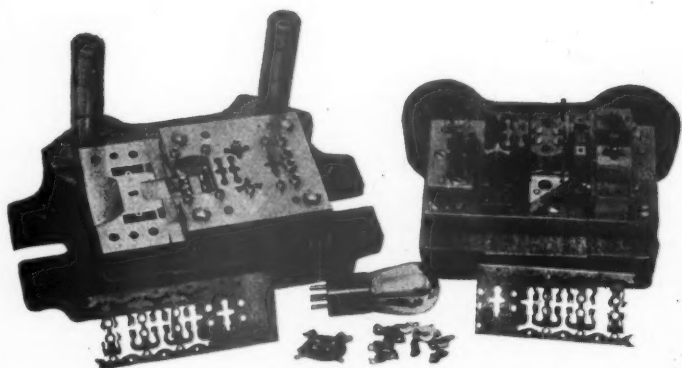
Paralleling the current shortage of skilled labour is a scarcity of high-calibred executive talent. This "bottleneck in bosses" is likely to lead to an extension of supervisory merit-rating plans, which many companies have used effectively to appraise the performance and promotional potentialities of foremen and junior executives. The author here presents a summary of the supervisory rating policies of a number of selected firms, and attempts to apply the best features of each to the establishment of a model merit-rating programme.

Reduction of Defective Workmanship—An Industrial Relations Function, by T. O. Armstrong. (*Personnel*, November, 1940, Vol. 17, No. 2, p. 134, 3 figs.).

When production activity expands, when companies go from single to multiple-shift operations, and the general accent is on greater output, then scrap and rejects mount. In this article is told how the Industrial Relations Department of the East Springfield Works of Westinghouse went to work on reducing waste caused by defective workmanship. The article describes how the programme was mapped out, how the union was called into the campaign, and also how the defective workmanship bogey was licked.

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SMALL TOOLS.

Die Design and Construction. (*Machinery, December 26, 1940, Vol. 57, No. 1472, p. 337, 4 figs.*).

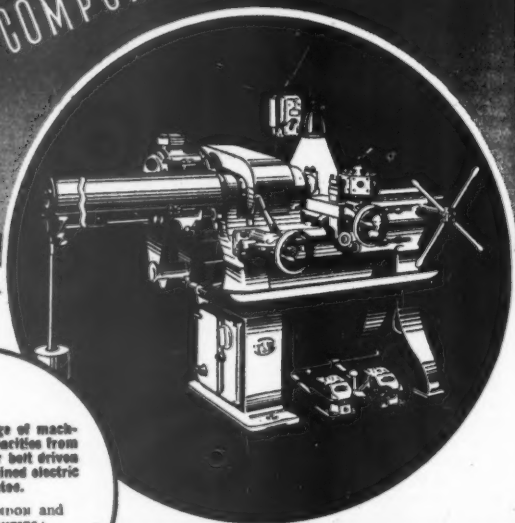
Combination solid forming and pressure-pad forming. Pressure-pad types of forming dies. Cutting-off and forming dies for draw forming. Piercing, cutting-off and forming die for combination solid and pressure-pad forming. Diagrams showing method of using spring pin in punch to prevent blank from shifting.

SURFACE, SURFACE TREATMENT.

Chromium Hardening can Increase the Useful Life of Machine Parts. (*Sheet Metal Industries, December, 1940, Vol. 14, No. 164, p. 1295*).

Characteristics of the deposit. The hardness ranges from over 600 Brinell to about 900, but the deposit is extremely brittle in the highest ranges. Wear of chromium-plated surfaces is low, not only on account of the hardness, but also because of the low coefficient of friction possessed by chromium, which is 30% lower than that of any other metal. Chromium is stable in air, no change taking place up to at least 300°C., and this is of little account until 700°C. has been exceeded. Very fine cracks may be seen under the microscope, so that the underlying basis metal may be attacked readily. Purely decorative deposits may sometimes not exceed 0.00005 in. in thickness hard coatings usually range from 0.003 to 0.005 in. Failures are sometimes traced to the unsuitability of the metal supporting the chromium. The coating cannot withstand much bending without the development of cracks. In general, therefore, the underlying material is steel, often alloy steel, and usually in the heat-treated state. Copper and copper alloys do not appear to be chrome hardened to any extent, except printing cylinders and blocks, but there have been a few examples recently of the use of this process to improve the wearing capacity of aluminium alloys. Principles of chrome plating. solutions. A satisfactory composition is from 25 to 35% pure chromic oxide in distilled water with sulphuric acid to give a $\text{CrO}_3/\text{H}_2\text{SO}_4$ ratio of 100 to 1, i.e., 0.25 to 0.35% by weight. Chrome hardening is applicable to any surfaces which are required to withstand corrosion, elevated temperatures, erosive and other wearing forces or, more often, a combination of two or more of these, while reduction in friction is also the feature desired in some cases. Plug gauges were rebuilt to size from 0.001 in. to 0.003 in., being the general thickness added. The life of the gauge increases from five to ten times that of unplated steel. Reamers, taps, dies and sometimes broaches are also chrome hardened. Other cutters are plated with chromium just behind the cutting face, to provide a hard surface of low frictional properties to which the chips do not stick. Press tools and certain types of punches benefit from chrome surfacing. The life of well-designed press dies can be easily increased five or six times by plating, while the use of chromium for building up worn shafts and cranks makes them better than new. In the steel mill chrome hardening is still a luxury reserved for finishers which have to yield a mirror-like surface on the sheet. Die-casting moulds employ chrome-facing in the places where wear is most serious, while the plastics industry also appreciates this method of increasing mould life. The use of 0.002 in. to 0.003 in. chromium over 0.001 in. nickel on moulds for glass bottles and other glassware not only increases the mould life but also improves the finish of the articles. Of essential importance are preparation of the article, control of the plating process, care of the worker, and costs. It is obviously impossible to give definite figures for costs owing to the wide variations between one firm and another, but a tentative average would be between 2s. and 3s. 6d. per 0.001 in. of chromium per 10 sq. ft. of surface area.

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Developments in Connection with the Bullard-Dunn Pickling Process, by Dr. John Kronsbein. (*Journal of the Electrodepositors' Technical Society*, 1940 Vol. 16, p. 55).

The iron or steel article to be descaled is made the cathode in a hot dilute, sulphuric acid solution, comprising a small amount of tin sulphate. The current density employed is of the order of 60 to 80 amps. per sq. ft., which causes copious hydrogen evolution at the surface of the work and thereby assists the acid in removing the scale. As soon as scale is removed from the article a protective film of tin is plated upon the cleaned portion of work, thereby preventing further attack on the article by the acid. This process continues until all the scale is removed and the entire article covered by a protective film of tin. The process is extremely easy to use, and entirely prevents the differential attack found in ordinary acid pickling processes. (I) Embrittlement. Tests have shown that ageing from one to fourteen days at room temperature, heating in air at 212°F. for about two hours, or immersion in boiling water for a similar period will remove all embrittlement. One aircraft factory in the United States bake all their work treated by the Bullard-Dunn process at 290°F. for one hour. (II)—Corrosion tests of Bullard-Dunn cleaned metal. The following types of specimens were included: (1) Unplated and painted; (2) shot-blasted, parkerised and painted; (3) Bullard-Dunn cleaned, tin stripped and painted; (4) Bullard-Dunn cleaned, tin not stripped and painted. Results: The Bullard-Dunn specimens with the tin not removed showed up as being affected by the test approximately 25% as much as the completely uncleaned specimens. It also shows approximately 50% of the corrosion of the shot-blasted phosphate-coated specimens.

Tin Electrodeposition in its Field in Industry, by S. Baier and W. H. Tait. (*Journal of the Electrodepositors' Technical Society*, 1940, Vol. 16, p. 45).

The special value of electro-tinning in industry derives both from the properties of metallic tin and from the particular features of coatings produced by electrodeposition methods. Tin is of great value as an anti-friction medium due to the remarkable manner in which tin and tin alloy surfaces retain thin films of lubricating oils. Tin and tin coatings are also resistant to many types of corrosion and, as they are completely non-toxic, they are perfectly safe to use in contact with foodstuffs. Properties: (1) Non-toxicity; (2) corrosion resistance; (3) anti-friction properties; (4) low melting point; (5) softness; (6) colour. (1) Electrodeposited coatings can be produced in any desired thickness, usually about 0.0001 in., according to the applications for which they are needed. (2) Electrodeposition can give coatings of very uniform thickness. (3) Electro-tin coatings can be applied to most base metals and alloys. Types of electro-tinning baths. Uses of electro-tinned coatings. I—Applications in connection with foodstuffs. (a) Domestic hollowware; (b) refrigerators, gas and electric cookers; (c) food processing equipment; (d) caps for milk bottles. II—Applications for general corrosion resistance: (a) Thin coatings of around 0.00005 in.; (b) moderate coatings of copper parts for protection against corrosion by water. III—Anti-friction coatings, e.g., tin-plated cast-iron pistons. The coatings used are around 0.001 in. thick. IV—Electro-tinning prior to soldering. V—Miscellaneous applications. Coatings from 0.002 in. to 0.005 in. are applied to parts which abut together. A final suggested use is for reducing the finger-staining of cadmium coatings.



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WELDING, BRAZING, SOLDERING.

Metrovick Resistance Welding Machines, by Dorrat. (*M.V. Gazette*, September, 1940, p. 52).

Some of the special resistance welding machines devised by M.-V. are described. Spot welding machines range from light-duty bench-type welders, where pressure and length of weld are controlled by the operator, to the heavy-duty type, with which infinite variation of welding heat may be obtained by means of "phase control" incorporated in the ignition control system, and also by electrically operated air valves, a definite pressure cycle may be applied during welding. The M.-V. portable spot-welding machine and the Aircraft type spot-welding machine are also described. Butt-welding machines, where correct balance between pressures, "push-ups" and welding currents is essential, and seam-welding machines are briefly reviewed. (*Abstract supplied by Research Department, Metropolitan-Vickers*).

Gas Welding of Grey Cast Iron. (*The Welding Industry*, December, 1940, Vol. VIII, No. 11, p. 310, 4 figs.).

Because cast-iron has no ductility it is necessary that the welding procedure have some method to reduce the rate of cooling after a weld has been deposited. This means that pre-warming or preheating should be used. Uniform cooling rate. Uniform rod analysis. Torch flame should be neutral, and the torch should not be directed at the molten pool, but rather at the tip of the filler rod. Characteristics of single-run fillets. Angle of electrode. Standard dimensions of fillet. Cross-sectional profiles of fillets. Economic characteristics of fillet weld. Comparative areas of single and double fillets.

Fluxes for Soft Soldering, by R. G. Harper. (*Aircraft Production*, December, 1940, Vol. II, No. 12, p. 393).

The function of the flux is to ensure that the basis metal is wetted by the molten solder. The flux, therefore, must ensure that clean basis metal and clean molten solder come into contact. If the cleaning action is at all pronounced the flux is described as active. Comparison of flux activity: Metal. Condition. Result of spreading test: (a) resin base; (b) oleic acid; (c) chloride base. Grouping of metals. Active fluxes are solutions of inorganic salts in water. All fluxes, in varying degrees, show chemical activity at the soldering temperature. After soldering, a small amount of flux may be left on the joint, and if this retains its activity, corrosion of the joint is likely to occur. The behaviour of the residue is often the factor which determines the employment of a particular flux. Wherever possible, however, the joint should be thoroughly washed either in hot water or in a very weak solution (1% strength) of hydrochloric acid, followed by a swill in cold water. Active fluxes in paste form. Fluxes based on ortho-phosphoric acid are considered separately. In soldering they are active, in so far as they give good results on many types of iron and steel, including alloy steels, and also on nickel and chromium, as well as copper alloys, including aluminium bronze. The interesting feature is that the flux residue forms on the surface of the basis metal a film of insoluble phosphate which provides protection against further attack and, moreover, against corrosion by outside agencies, the film being similar to that produced in rust-proofing processes.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

COOLANT, LUBRICANT.

Magnetic Filtration of Cutting Oils, by N. C. Pratt. (*Machine Shop Magazine*, January, 1941, Vol. 2, No. 1, p. 69; 4 figs.).

Removal of fine swarf. The success of the magnetic filter for cleaning and reconditioning cutting oils. Construction. A sectional diagram shows the operation of the filter. Showing how swarf gathers at gaps.

FOUNDRY, MOULDING, MELTING.

Preparation of High Melting Alloys with the Aid of Electron Bombardment, (The Electron Bombardment Furnace), by R. Hultgren and M. H. Pakkala. (*Journal of Applied Physics*, October, 1940, Vol. 10, No. 11, p. 643).

The principle of electron bombardment is as follows: A hot filament is placed near a positively charged crucible in a vacuum. Electrons from the filament are accelerated by the voltage drop and strike the crucible. The kinetic energy of the electrons is given up in the form of heat. Thus all the power goes to the crucible. The temperature attainable is limited only by the refractoriness of the crucible. The construction of an electron bombardment furnace is described. It was designed for melting small quantities of metals. Pt, Ir, Fe, Co, V, Ti and Zr were melted without difficulty, and in one experiment a tantalum cup (n.p. 2850°C.) was melted with an expenditure of only 700 watts; this lowness of the power required is said to be general.

GEARING.

Ground Form Finishing Hobbs, by Chas. R. Staub. (*Machinery*, January 2, 1941, Vol. 57, No. 1473, p. 373; 14 figs.).

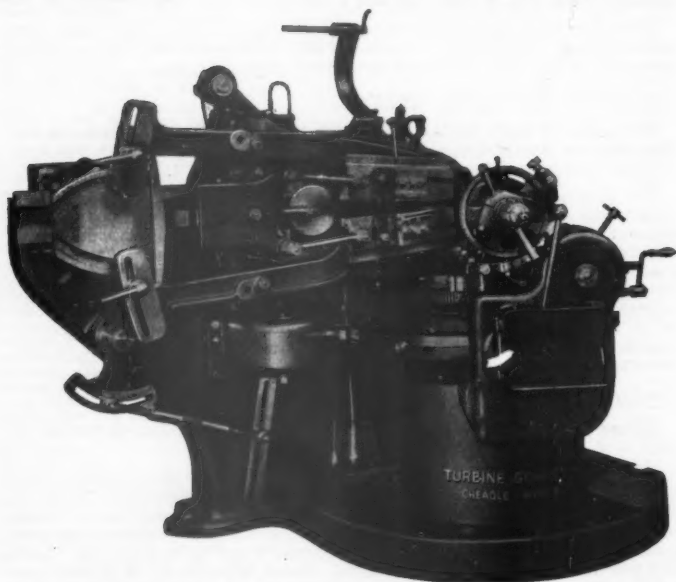
For the hobbing process it is of paramount importance that the lead of the hob should be accurate. The lead must not deviate more than 0.0005 in. from the true helical path of the thread in making a convolution. Where silent running, or exact uniformity of rotation is stipulated, relief-ground hobs should be employed. Diagram illustrating relief grinding on hob teeth. Table of limits for single and multiple thread ground hobs for finishing spur and spiral gears. Sine bar lead testing apparatus. A typical lead inspection chart for a gear hob. Correctly and incorrectly sharpened hob teeth. Hob centring gauges. Hob setting for precision gears. Hob run-out. Method of estimating the time required for hobbing gears. Chart giving recommended lengths for worm gear hobs. Table of spindle speeds for various hob diameters and cutting speeds.

HYDRAULICS.

Hydraulic Circuits with Pilot Valve and Mechanical Control, by J. C. Cotner. (*The Machinist*, January 18, 1941, Vol. 84, No. 48, p. 466E; 5 figs.).

Circuit for machine for bending cycle tubes. Milling machine circuit. Circuit for forming machine. Hydraulic shears circuit. Circuit for staking operations.

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This machine, which is manufactured at our Cheadle Heath works, is becoming increasingly popular due to the simplicity and cheapness of the cutting tools and the wide range of work which can be handled. It is easy to set up, quick in operation, and entirely automatic. A smaller machine is now made for up to 6 in. pitch circle diameter.

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JIGS AND FIXTURES.

The Edgwick Optical Dividing Head. (*Machinery, January 30, 1941, Vol. 57, No. 1477, p. 495; 3 figs.*).

This dividing head does not depend for its accuracy of mechanical means of division. Displacement of the spindle is read directly by means of the optical system, which is not subject to wear. The original accuracy of the head is thus maintained throughout its life. The divisions, representing ten seconds, appear in the eye-piece to be about 1.25 in. apart. Final reading can therefore be readily estimated to two seconds. On a diameter of 4 in two seconds correspond to a peripheral measurement of 0.00002 in.

KINEMATICS.

Sine Bars, by E. R. Gregg. (*Machine Shop Magazine, January, 1941, Vol. 2, No. 1, p. 53; 17 figs.*).

Outline of the principle underlying the use of the sine bar and to describe some developments that have been made to facilitate the application of that principle. Johansson sine bar. Buck and Hickman bar. The sine bar principle. Adjustable angle plates. A sine angle plate. The "Melbourne" table. Adjustable table with two plugs. A simple sine vice. "Magna-sine" table. Checking tapered work. Gear testing. Sine bar in use on gear testing machine.

CHIPLESS MACHINING.

Recent Developments in Metal Extrusion, by Albert B. Cudebec. (*Mechanical Engineering, January, 1941, Vol. 63, No. 1, p. 16; 2 figs.*).

Stainless steels, nickel alloys, bearing steel, and non-ferrous alloys now being extruded into tubing, rods and profiles. The figures show it is only during the last five years that the art has made its greatest contribution to industrial progress by the production of stainless steel, nickel-alloy, and bearing-steel tubing, shapes and rods. Modern 2,200-ton metal extrusion press for producing tubes, rods and profiles. Large pistonless air-hydraulic accumulator for operating several hydraulic presses at the same time, erected in 1939 in one of Great Britain's latest steel mills. The accumulator includes three high-pressure pumps (three-throw), 220-g.p.m. 550-h.p. motors, speed of crank-shaft 120 r.p.m.; total capacity of pressure vessels (air and water) 2,900 gallons, operating pressure 300 atm., approximately 4,300 p.s.i. The large modern tube extrusion press ranging from 4,000 tons to 6,600 tons capacity would never have been developed if it had not been for the pistonless air-hydraulic accumulator, with which it is driven. Most of the modern presses are the horizontal type, although some production managers still prefer the vertical design. Disadvantages and advantages of the vertical type. The advantages of the horizontal type are: (1) There is no practical limit of press capacity providing there is sufficient horizontal floor space. (2) Press operator can personally observe the extruded pieces as they emerge. (3) The cut-off device for removing the butts of the billets from the extruded pieces can be much more easily provided and operated. (4) It is also probable that the modern method of press suspension upon the foundations of the horizontal type largely eliminates variation in tube-wall thickness arising from expansion and contraction in the press, and it is now possible to produce tubing with concentric accuracy equal to that of tubes produced by vertical-type presses. Surface oxidation. Scrap losses. Tools. Tubing can be commercially extruded in sizes from a minimum of 1½ in. to 4 in. or 5 in. outside diameter, depending upon the capacity of the press.

Snow Table Surface Grinder (patented)



THIS Table Surface Grinder enables flat surfaces to be ground by hand, without skill and in perfect safety. Many jobs now being laboriously filed or ground on the ordinary wheel by hand in a very unsatisfactory manner, may be surfaced on this machine much more accurately, and in considerably less time. A flat surface is obtained by merely passing the work across the table. The Driving Motor is incorporated in the machine. Made in two sizes, with 14 in. and 20 in. diameter grinding wheel.

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PRODUCTION ENGINEERING ABSTRACTS

Pressures and Blanks for Press Work. (*The Machinist*, January 18, 1941 Vol. 84, No. 48, p. 933; 4 figs.).

Table giving tonnages per lineal foot for bending mild steel with air-bend dies. Length of blanks. Blank calculations. Table giving allowances for bends made across the grain in mild steel, using V-dies.

Forming and Stamping Aircraft Parts. (*Aircraft Production*, February, 1941 Vol. III, No. 28, p. 59; 17 figs.).

The urgent necessity for a manifold increase in the production of aircraft has stimulated the development of various forms of press technique. These are mainly designed to make use of the power press in such a way that the production of sheet metal parts shall be maintained at a reasonably economic figure for the small quantities required. Methods which were formerly employed principally for experimental and try-out purposes are now being adopted and improved for regular production. A 660-ton Lake Erie double-action hydraulic press set up for production of large pressings. A Cecostamp drop hammer used for forming sheet-metal components. Diagrammatic illustrations of the action of a rubber pad in shearing light-alloy sheet over a steel blanking template. Method of blanking a deep notch by means of a rubber pad. Blanking heavy-gauge material by the use of a rubber pad. The metal is stretched between the shearing edge of the template and the L-shaped auxiliary strip. Diagram illustrating the use of various grades of lubricant on different portions of a die for drawing part of a speed ring. Constructional details of a steel-faced forming die. Construction of a wood hand-forming block for flanging a duralumin rib. A group of forming blocks used in the manufacture of miscellaneous parts for a Curtiss aircraft. Masonite compressed wood is largely employed for tools of this kind.

MANUFACTURING METHODS.

Producing the "Shadow" Blenheim, by Bruce Foster. (*Aircraft Production*, January, 1941, Part I, Vol. III, No. 27, p. 7; 21 figs. Part II, February, 1941, Vol. III, No. 28, p. 45; 24 figs.).

Part I.—Rootes' factory in quantity production. Brief history of the scheme. Methods used on spars, wings and control surfaces. General arrangement for data for the "long-nosed" Bristol Blenheim. Material specifications Spar-drilling jigs.

Part II.—Building the front and rear sections of the fuselage. Works layout and equipment.

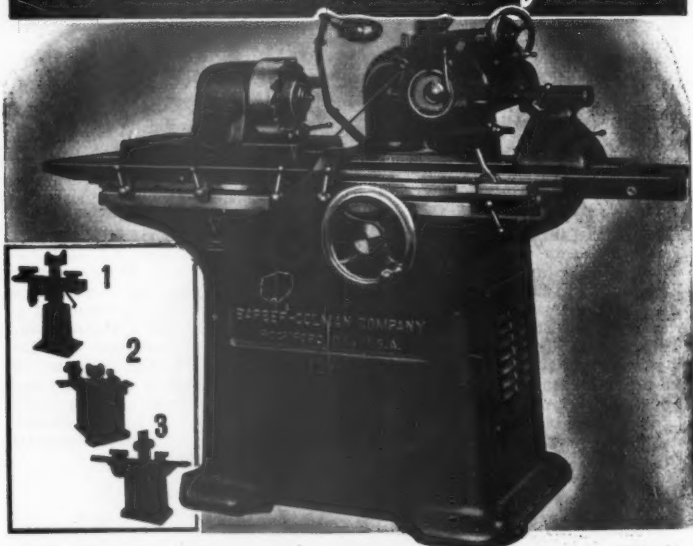
Different Diesels from One Line. (*The Machinist*, January 11, 1941, Vol. 84, No. 47, p. 910; 8 figs.).

Production machines in the Milwaukee Diesel engine shop just opened by International Harvester are interchangeably tooled in different units. A series of photos show the application.

Drilling Square, Hexagonal, Triangular and Other Polygonally Sided Holes by H. A. Dudgeon. (*Machinery*, January 16, 1941, Vol. 57, No. 1475, p. 429; 12 figs.).

Examples of polygonally sided holes to be drilled. Tool for drilling square hole with round corners. Movement of the cutter. Attachment for drilling square holes. Producing square holes with sharp corners. Angular holes may be drilled when the former rotates instead of the drill. Shape of cam for drilling square holes with sharp corners. Layout of tools for producing hexagonal holes with round corners. Cam and former for drilling hexagonal holes with sharp corners. Layout of cutter, cam and former for drilling equilateral triangular holes.

one machine instead of three



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WITH this one machine a wide variety of standard sharpening operations can be performed. In addition, several specialized grinding operations can be handled with greater speed and economy than formerly, yet with no sacrifice of accuracy. Following of spiral leads, indexing, diameter size, blade profile, feed to wheel on tooth face grinding, diameter cutting clearance, relief clearance, wheel dressing, radial faces on high spirals, all these important sharpening factors are under positive mechanical control, and all mechanical movements of the machine can be duplicated to assure uniformity of work on any number of pieces. The machine is equally adaptable for sharpening hobs, all makes of reamers, and milling cutters. For details write to

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'Grams "BARCOL." SALE.

Surface Broaching. (*Automobile Engineer*, January, 1941, Vol. XX XI No. 406, p. 3; 12 figs.).

Surface broaching operations on cylinder blocks, gear boxes, connecting rods and main bearing caps are described in detail. The types of machines employed are briefly referred to and particulars are given of several interesting work-holding fixtures designed for rapid and accurate location of the workpiece. Where sufficiently large quantities are involved, surface broaching is a very effective and economical finishing method.

Sheet Shapes for Aircraft, by Louis H. Biehler. (*The Machinist*, January 18, 1941, Vol. 84, No. 48, p. 926; 4 figs.).

A special system of drilling and routing permits multiple profiling of many sheet aluminium aircraft parts. With this method small lots can be turned out efficiently.

MATERIALS, MATERIAL TESTING.

Magnesium Alloys. (*Aircraft Production*, January, 1941, Vol. III, No. 27, p. 17).

A few years ago the demand for speed and efficiency in aircraft led to an almost general change-over from wood to aluminium alloys as a material for air-frame construction. In a paper recently presented to the National Aircraft Production Meeting of the Society of Automotive Engineers, John C. Mathes, of the Dow Chemical Company, suggests that this latter material will, in turn, be eventually replaced by magnesium alloys. This would, of course, be in addition to the increasing use of magnesium castings for engine components and other parts. Accompanying is an abridged version of the paper.

Magnesium Alloys in Aircraft—Details of American Practice, by N. E. Woldman. (*Metal Industry, U.S.A.*, Vol. 57, No. 24, December 13, 1940, p. 465).

Magnesium alloys can be produced in the following forms: (i) castings—sand cast, permanent mould, and die cast; (ii) forgings—hammer and press forgings; (iii) wrought—extrusions, sheets, plates and bars. The constitution and physical properties of the casting, forging and wrought alloys are discussed. Not all of them are susceptible to heat treatment. The latter, which is a solution treatment, with or without an ageing treatment, produces the optimum physical properties. The solution treatment consists in heating the parts to 650 to 720°F. for a sufficient time (sixteen to twenty hours) until the insoluble constituents go into solution and then air cooling. This treatment increases the strength and ductility to maximum toughness. Then followed by ageing for twelve to sixteen hours at 340 to 400°, the tensile strength and hardness are further increased with a sacrifice in ductility. Magnesium alloys, while possessing good tensile and fatigue properties, are very notch-sensitive. Hence notches, scratches, sharp corners must be avoided, also cavities, in which moisture can accumulate and cause corrosion. Electrolytic corrosion in contact with brass and steel is prevented by plating with cadmium. Mg. alloys can safely be used at low temperatures, but are not recommended for resistance to wear. Salt water corrosion is prevented by an anti-corrosive treatment known as chrome pickle ($\text{Na}_2\text{CrO}_4 + \text{Conc. HNO}_3 + \text{Water}$). This produces a yellow porous coating of chromates which has definite anti-corrosive properties, and at the same time provides a good base for painting. (Communicated by D. S. R., Ministry of Aircraft Production).

Tests on Lead Bronze Bearings in the DVL Bearing Testing Machine, by G. Fischer (Germany). (*L.F.F.*, Vol. 16, No. 7, July 20, 1939, p. 370). (Translation available as N.A.C.A. Tech. Memo., No. 943.)

NORTON ABRASIVES



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The tests were carried out on 12 lead bronze bearings supplied by five manufacturers, the lead content varying between 20 and 40%.

All the bearings had a steel shell backing, the actual bronze deposit (cast on) being about .5 mm. (0.02 in.) thick. Similar tests on light alloy bearing metals are described by the same author in *L.F.F.*, Vol. 16, p. 1.

The original DVL bearing testing machine is described in an article by O. Meyer (*L.F.F.*, Vol. 14, No. 1, January 20, 1937, p. 14). In this machine the bearing rotates about a fixed shaft, whilst a variable load in a fixed direction can be applied to the outside of the bearing by means of an ingenious toggle mechanism. In this way the force distribution over the bearing surface can be made to approach that existing in an engine under load. All the bearings tested were 60 mm. (2 3/8 in.) inside diameter, approximately .5 mm. (0.02 in.) thick, and the width of running surface 25 mm. (1 in.). The rubbing speed was 5 m./sec. (16 fet./sec.), and the temperature of the shaft at a point near the oil film was kept at 120°C. (248°F.) by adjusting the oil circulation. Friction force is not measured by this machine, which is entirely intended to permit rapid examination of the bearing for marks of wear or injury. A safety cut-out device is however provided which stops the machine should the power absorbed increase by more than 50%.

Only two of the bearings carried out satisfactorily the specified endurance run of 100 hours at a static load of 250 kg./cm. (85 lb./sq. in.). (In these tests the toggle mechanism is clamped). Apparently running conditions under dynamic load are less onerous, since the oil film can reform itself during the low-pressure periods.

It appears that the main difficulty is to ensure a uniform fine globular lead distribution in the original casting. It is well known that such a desirable grain structure requires a low pouring temperature and fast quenching. Unfortunately, this reduces the bonding to the steel shell backing. The use of a high frequency electric furnace for the melting seems to improve grain structure. Active research for some alloying component producing the same result has not yet given any satisfactory results, and the possibility of fastening the bronze to the steel shell by some alternative method to casting is also receiving attention. (A. Blankenfeld, *Z. für Metallkunde*, Vol. 31, No. 2, 1939, p. 31.). (Communicated by D.S.K., Ministry of Aircraft Production).

MEASURING METHODS, APPARATUS.

Optical Flats. (*Aircraft Production*, January, 1941, Vol. III, No. 27, p. 34; 6 figs.).

The use of optical flats is based on the fact that, if a glass or quartz plate is put into close contact with the surface of another plate a series of colour fringes or bands will be visible and these will indicate the inaccuracies of the surface being checked. These colour fringes are produced by the interference of light reflected from the two contacting surfaces. It is known that the distance between each two colour fringes represents a surface inaccuracy of 0.00001 in., so a definite basis for comparison is available. Characteristic appearances of the colour fringes for various surface conditions. Checking a test block for height against a known standard gauge. Use of optical flats in measuring a test piece the faces of which are not parallel. Determining the relationship between two surfaces, where that of the test block is inclined diagonally to the slope of the optical flat.

Non-destructive Production Tests for Steel Tubing. (*Steel*, October 21, 1940, pp. 38 and 75; 7 figs.).

A test for defects in tubing which is entirely independent of the magnetic properties of the tube has been developed by Sperry Products Inc. The detector equipment for production inspection work described in this article

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is provided with alternative automatic or manual control. An energising coil is employed which induces current in a circular direction in the tube, and a search coil picks out defects. The searching unit output is amplified by electronic equipment and operates visual signals and a motor relay controlling the passage of the tube through the detector. (*Communicated by Research Dept., Metropolitan-Vickers.*)

MECHANICS, MATHEMATICS.

Chutes—How to Design and Make Them. (*Sheet Metal Industries, January 1941, Vol. 15, No. 165, p. 63; 6 figs.*.)

The object is to convey material by gravitation down a slope from one point to another; the angle of the slope is clearly an important factor in ensuring the success of the chute, although much, of course, depends upon the nature of the material to be conveyed. Angle of fall for breakable goods. Stone and rubble, fine powders, etc. The minimum at which a chute should be set for the material under consideration is shown. The chute forms a connecting link between elevator heads and hoppers or bunkers, screw or chain conveyors, and also between cross conveyors and from conveyor outlets to process machines. A typical sheet metal chute between two square frames, and the diamond shape of the cross section. The correct angles may be determined either geometrically or by calculation. Outlet at the head of an elevator.

POWER, DRIVE.

Drive Design—A Review of Driving Media, by R. O. Baird. (*Power Transmission, January, 1941, Vol. 9, No. 108, p. 549.*)

Part III.—Chain drives. Chain types. The roller type and the inverted tooth type. The best arrangement for chain driving is with the chain horizontal or nearly so, and steeply inclined or vertical drives should be avoided if possible. Where possible, the inclination of the slack side of the chain to the horizontal should not be more than 60° . Short-centre distances are possible with this form of drive. The centre distance should not exceed 100 pitches for the smaller roller chains, or 70 pitches for roller chains of 2 in. pitch or over. For chains of the inverted tooth type the centre distance should be limited to 70 pitches in the smaller sizes and to 50 pitches in the larger sizes. Some provision should be made in the design for adjusting the centre distance to take up the increase in length of the chain which occurs in service. It will be found advisable to provide a minimum centre distance adjustment of $1\frac{1}{2}$ pitches, such centre adjustment being also a convenience in the initial fitting up. Other measures resorted to are the use of jockey sprockets and of slippers bearing against the chain. As a first step in designing a drive, the facts to be ascertained are the driving sprocket r.p.m., the ratio required, the horse-power to be transmitted and the approximate centre distance. Allow suitable factors for shock, pulsating loads, etc. In so far as high speed drives are concerned, the drive should be enclosed in a chain case and oil lubricated. Careful erection is called for if the drive is to be satisfactory. The two shafts must be levelled and checked for parallelity, and the sprockets lined up accurately by the usual methods. Maintenance normally will consist of periodic inspection, lubrication and cleaning being carried out at regular intervals, usually about every three months.

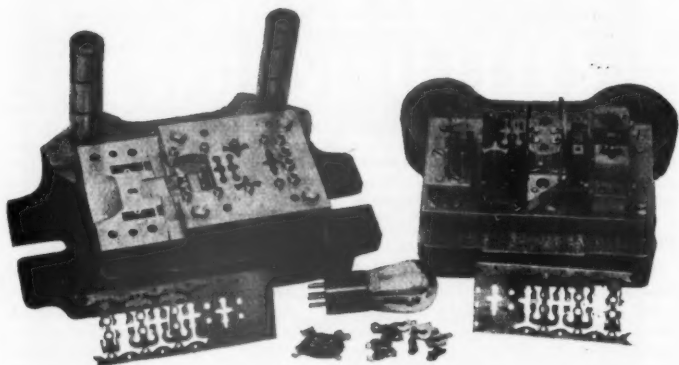
PSYCHOLOGICAL INVESTIGATION.

Some Psychological Problems of the Scientific Worker, by Charles S. Myers. (*Occupational Psychology, January, 1941, Vol. XV, No. 1, p. 26.*)

Some general problems of scientific workers of various grades—technical research workers, routine workers and "service" workers—employed by

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industrial, commercial or Government organisations. Conditions under which certain kinds of work are best done, the temperamental qualities which may be called for, and possible improvements in methods of selecting and training.

RETAILING.

Swarf and Scrap Metal, by D. F. Galloway. (*Mechanical World*, January 24, 1941, Vol. CIX, No. 2821, p. 53; 11 figs.).

The processes involved and the various means available for performing each stage of the disposal. (1) Initial control of scrap metal as it is removed from the bar or strip, leaving the required work-piece. (2) Immediate storage of swarf in or near machine base. (3) Removal of scrap to main storage or sorting department. (4) Separation of coolant from swarf and breaking if necessary. (5) Sorting of different materials if necessary. (6) Baling, storage, and removal to melting plant. The illustrations show: chip breakers of cutting tools; a cam-operated deflector for separating work-pieces from swarf; several swarf disposals for machine tools; the magnetic method of separating steel from oil; swarf breaking machines. Finally the swarf-sorting methods are discussed.

SHOP, SHOP MANAGEMENT.

The Works of the Churchill Machine Tool Co. Ltd., Manchester. (*Report, British Machine Tool Engineering*, Vol. XXII, No. 126, November-December, 1940, p. 318; 202 figs.).

The article contains the layout of the Churchill works, illustrates by magnificent figures the various departments (turning, milling, gear cutting, grinding, boring, drilling, toolroom), and devotes particular attention to the system of inspection checks which ensure the high accuracy of the Churchill products. A reproduction of the alignment chart (Fig. 135) used for all types of Churchill plain grinding machines show nine main tests as an attempt to satisfy the user. The permissible errors correspond closely to the tolerances of the acceptance test chart of the Institution of Mechanical and Production Engineers.

SMALL TOOLS.

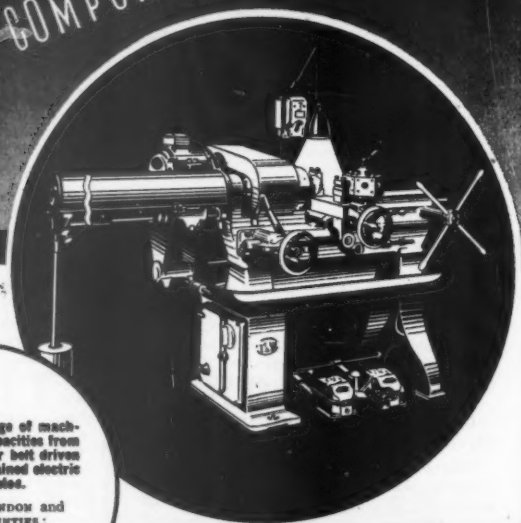
How to Use Dressing Tools, by Wills, J. H. (*The Machinist*, January 11, 1941, Vol. 84, No. 47, p. 914; 4 figs.).

Dressing grinding wheels at regular intervals following a standard procedure is more economical than dressing when the wheel seems to be loaded. For best results the diamond dressing tool must be set up at an angle with the wheel face. Never set the stone above the radial line of the wheel, or chattering and gouging are to be expected. To avoid diamond marks on the wheel, set the tool at 60° with the face of the wheel in the horizontal plane.

Carbides for Cutting Steel, by Philip M. McKenna. (*The Machinist*, January 18, 1941, Vol. 84, No. 48, p. 917; 10 figs.).

Development of a crystalline intermetallic compound, a double carbide of titanium and tungsten, corresponding to the chemical formula $WTiC_2$. For steel cutting these compounds have 67 Rockwell C, and have strength in cross rupture which approaches that of high-speed steel. They are not so rigid as tungsten carbide compositions. Turning tools for steel parts. Comparative chart of machining speeds with single-point tools on commercial steels, such as SAE 1045, SAE 3140 and SAE 4320, of varying degrees of hardness. Drawings of carbide-tipped tools suitable for many facing cuts in steel with and without chip breakers. A chip-breaker groove is not necessary

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for most facing operations. Carbide-tipped boring tools. Carbide-tipped form tools illustrated. Cut-off tools. Manufacturers of grinding wheels have produced special loose-bond silicon carbide grinding wheels which are suitable for free-hand grinding, constant motion of the tool being essential. Diamond, impregnated bakelite-bond wheels are cheaper in the long run, whether the tools are ground free-hand or in a fixture.

SURFACE, SURFACE TREATMENT.

Pickling Strip Steel, by C. C. Downie. (*Machinery*, January 30, 1941, Vol. 57-No. 1477, p. 489).

Measuring the thickness of deposits. Large-scale pickling methods. Modern heating and control systems. Electrolytic cleaning.

WELDING, BRAZING, SOLDERING.

Oxy-acetylene Welding of Light Aircraft, by Hanfold Eckman. (*The Welding Industry*, January, 1941, Vol. VIII, No. 12, p. 337; 4 figs.).

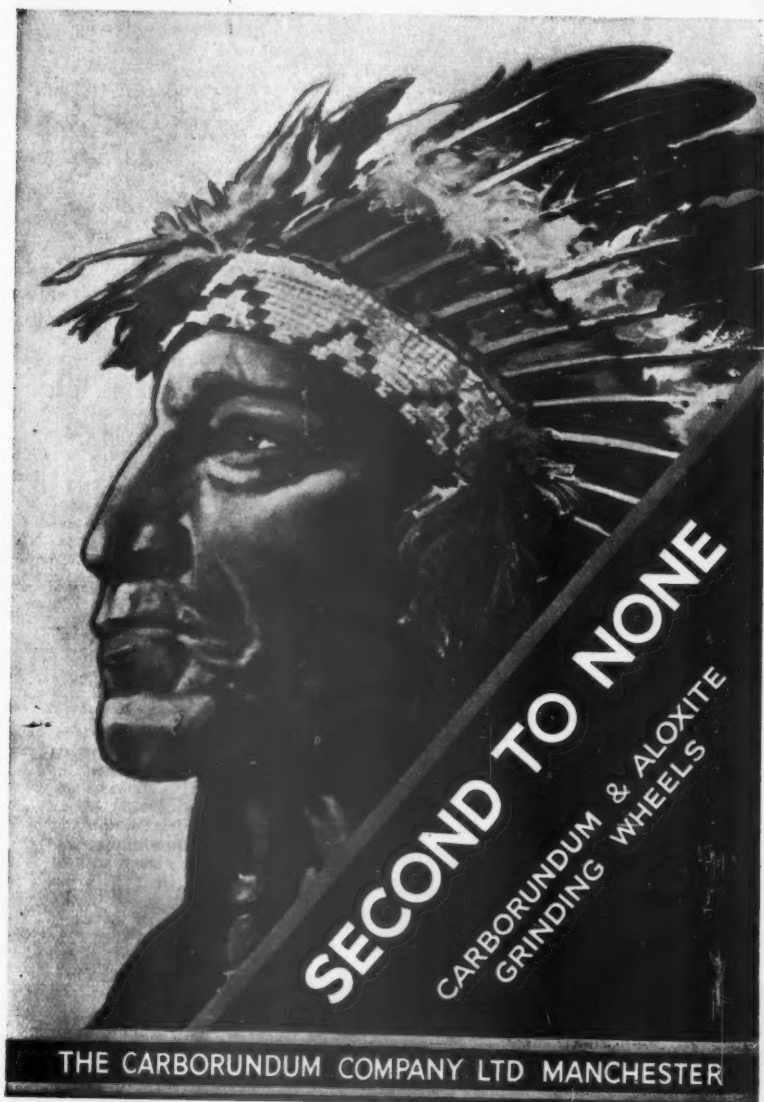
The light plane, by definition, is one that has an engine of 75 h.p. or less. For the light plane, welded tubular design at present allows the most satisfactory method of construction because it permits a high rate of production with a minimum of special tools and jigs. Construction developments. Two sketches indicate the metallurgical factors (1) in neutral flame welding, (2) in excess acetylene welding. Welding chromium-molybdenum. Welding rods. Grain growth control. Welding applications.

Spot Welding in Aircraft Construction, by Charles F. Marschner. (*The Welding Industry*, January, 1941, Vol. VIII, No. 12, p. 333; 2 figs.).

Two fields; the welding of aluminium alloys and the alloys of steel. The subject is sub-divided in: (1) equipment, (2) operators, (3) design, and (4) shop procedures. The equipment on hand should be capable of welding all gauge combinations between the range of two pieces of 0.016 in. up to two pieces of 0.125 in. stock. Some of the equipment should also have sufficiently low heat adjustment to permit the welding of stainless steel through the range of 0.010 in. to 0.064 in. stock for such parts as fire walls, shroud bridges, baffles, etc., which cannot be made from aluminium. The controls for adjustment of the welding variables should be of the dial type, each being calibrated to give directly the output amperage, time and pressure as the case may be. In order that quality and uniformity of welds may be maintained at all times, close co-ordination between factory and engineering is required. It is necessary to set up welding standards in the shop which must be rigidly adhered to. In general it may be said that the ratio of the cost per rivet to the cost per weld is about 10 to 1. The ratio is based on the assumption that about 5,800 welds can be produced per machine every eight-hour shift. Comparison between riveting and spot welding on a typical spot-welded aluminium alloy aeroplane on which over 50% of the welding was on the basic structure. An increasingly more important feature and advantage of spot welding is the flush surface condition permitted by its use. Another advantage lies in the weight saving resulting from the elimination of rivet heads. On the average, 1 lb. is saved for every 2,415 rivets replaced.

Welding of Airframes, by W. S. Corns. (*Aircraft Production*, January, 1941, Vol. III, No. 27, p. 21; 9 figs.).

Aircraft embodying fuselages with tubular framework have given excellent results under active service conditions. In conjunction with welding, this form of construction offers a method of achieving a high rate of production, as it makes for economy in tooling, simplicity of manufacture and ease in the installation of equipment.



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Saving with Brazing, by A. K. Phillippi. (*The Machinist*, January 11, 1941, Vol. 84, No. 47, p. 903; 9 figs.).

Copper brazing in controlled-atmosphere furnaces proves an effective method of saving on assembling and cleaning costs. Examples: (1) Muffler assembly. (2) Float ball. (3) Steel tube brazed to cold-rolled flanges. (4) Strainer, especially designed for furnace brazing. (5) Small refrigerator mechanism parts. Heat-treating effect of the brazing furnace eliminates a separate annealing. Typical controlled-atmosphere electric furnaces for copper brazing are completely automatic in operation, and can be adjusted to handle a wide variety of parts. Atmosphere is precombusted coal and water gas.

WELFARE, SAFETY, ACCIDENTS.

Protective Clothing. (*Industrial Welfare and Personnel Management*, January, 1941, Vol. XXIII, No. 266, p. 13; 4 figs.).

Head shield worn by electric welder. Goggles of unsplinterable glass. Man wearing these escaped all injury. Steel toe capped boots. Wearer unhurt by 2 ton weight falling on it. Hand-protector of crepe rubber for handling pig iron.

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Research Department: Production Engineering Abstracts

(Edited by Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College Loughborough.

ANNEALING, HARDENING, TEMPERING.

"Tocco" Process for Hardening Steel Surfaces. (*Engineering*, November 29, 1940, p. 426).

A process has been developed in the U.S.A. whereby steel surfaces can be hardened locally to increase resistance to wear. Heating of the part is effected in a few seconds by high frequency induction, and quenching done by means of high-pressure water jets. The process and the factors which influence it are discussed and data given relating to the increased hardness of the treated surface.

ACCOUNTING, ADMINISTRATION.

The Third and Fourth Reports from the Select Committee on National Expenditure. (*The Cost Accountant*, January-February, 1941, Vol. 20, No. 8, p. 93).

Labour and overtime. The use of costs contracts. "Adjusted price" contracts. Contractors' incentive; allocating overheads; efficiency from costing; profits. The contracts co-ordinating committee; standard contract clause; knowledge of markets. Principal conclusions.

War Risk Insurance for Industrial Concerns. (*American Management Association Insurance Series* No. 37).

War risk covers:

(1) *Fire*, by R. J. Folonie.

The definition of "war." Mandatory endorsement, vandalism and malicious mischief, exceptions; use and occupancy; war risk and bombardment policy.

(2) *Marine*, by R. W. Cauchois.

"Missing vessels" insurance. British Trust Fund in New York. The "Minden" case. The "Fall or Capture" problem.

(3) *Casualty Insurance*, by J. C. L. Bowman.

Workmen's compensation; public liability contractual liability; property damage; crime.

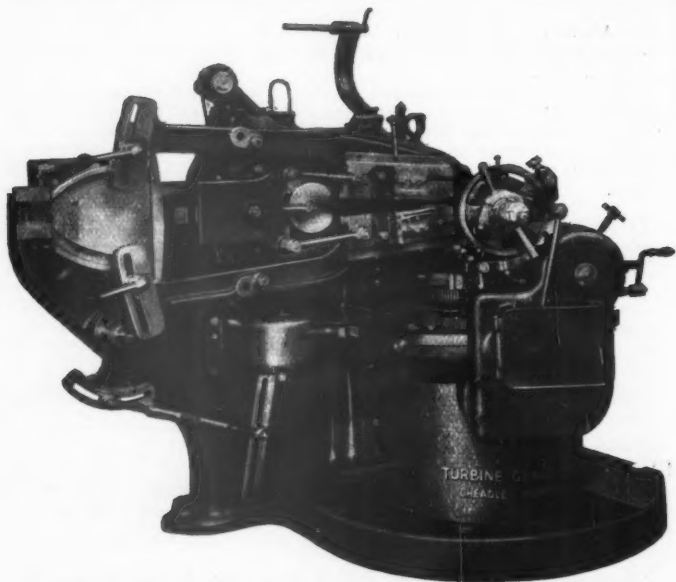
EMPLOYEES, WORKMEN, APPRENTICES, ETC.

Selection and Development of Foremen and Workers. (*American Management Association*, No. 127, November 12, 1940, pp. 3, 13, 20, 25, 32).

(1) *Which men make the best foremen?* by Stewart M. Lowry.

Some foreman specifications. Leadership. The rating. Mental alertness measurement. An elimination process. College-trained foremen.

BEVEL GEAR GENERATOR



This machine, which is manufactured at our Cheadle Heath works, is becoming increasingly popular due to the simplicity and cheapness of the cutting tools and the wide range of work which can be handled. It is easy to set up, quick in operation, and entirely automatic. A smaller machine is now made for up to 6 in. pitch circle diameter.

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(2) *Developing effective supervision*, by Wendell M. Nelson.

The "General Electric" foremen training method. Another type of course formed. Conferences for all supervisors. The leadership and "criticism" problems. Men arrange programme.

(3) *The foreman's own point of view*, by A. C. Horrocks.

Better men and lower costs. The transition of the foreman. Handling men management's opportunity. The Goodyear way.

(4) *The right man for the right job*, by George H. Prudden.

Good and bad results. The forms used. Trade tests. Humm-Wadsworth test.

(5) *New developments in the selection of factory workers*, by Charles A. Drake.

Performance tests. Twenty-two industrial tests. Further breakdown. Percentage efficiencies. Distribution of scores.

GEARING.

Fellows Involute Testing Machine. (*Machine Tool Review*, September-December, 1940, Vol. 28, No. 176, p. 179, 9 figs.).

Diagram showing rough setting for base radius and setting for radial position. Setting involute pointer to correct base circle radius. Checking operation of machine using a calibrated master involute. Setting of involute pointer relative to surface of gear tooth. Diagram illustrating gear tooth action. Diagram illustrating high fillet, undercut and tip modification with charts produced on electrical recorder. Setting of involute pointer when base radius lies inside or near root circle.

HEAT ECONOMY.

Principles and Applications of Automatic Temperature Control, by M. J. Gartside. (*The Heating and Ventilating Engineer*, February, 1941, Vol. XIV, No. 164, p. 322, 12 figs.).

Generally speaking, a thermostat, or temperature control device, consists essentially of an element, sensitive to temperature, which is located in the medium to be controlled. (i) "On-off" system of control. (ii) "Floating" control. (iii) "Modulating" or "proportioning" control. Use of modulating control. Heat acceleration. Design of the thermally sensitive member. Function of the thermally sensitive member. Diagrammatic view of bimetal/micro-gap switch thermostat. Interior view of vapour pressure/mercury tube thermostat. Sectioned view of steam valve directly operated by vapour pressure system. Directly operated thermostatic damper control for domestic hand-fired boiler. Diagrammatic view of arrangement of air or water-operated control system. Diagrammatic view of self-contained electrically and oil pressure operated modulating valve. Compensated control. Inside-outside temperature control for central heating plant. Choice of type of instrument. Applications: process vats, liquid tanks, etc. Automatic operation of drying plants. Fuel oil burning. Central heating. Diagrammatic arrangement of controls for typical central-heating and hot-water supply system. Diagram illustrating aspect control.

JIGS AND FIXTURES

Jigs and Fixtures (2). (*Machine Tool Review*, September-December, 1940 Vol. 28, No. 176, p. 157, 12 figs.).

Chucking fixtures for capstan and turret lathes. Cradle type fixture for holding a pump body, cradle type fixture for an induction casing cover.

Snow Table Surface Grinder (patented)



THIS Table Surface Grinder enables flat surfaces to be ground by hand, without skill and in perfect safety. Many jobs now being laboriously filed or ground on the ordinary wheel by hand in a very unsatisfactory manner, may be surfaced on this machine much more accurately, and in considerably less time. A flat surface is obtained by merely passing the work across the table. The Driving Motor is incorporated in the machine. Made in two sizes, with 14 in. and 20 in. diameter grinding wheel.

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Face-plate fixture for holding a motor-cycle crankcase cover. Two station indexing fixture for holding an inlet pipe elbow for facing operations. Front part of the fixture for holding a pump body in which two parallel holes have to be bored. Two-station indexing mechanism to which the fixture is bolted.

MANUFACTURING METHODS.

Mass Production of Precision Bevel Gear Blanks, by F. M. L. (*Machinery*, February 27, 1941, Vol. 57, No. 1481, p. 597, 6 figs.).

In the mass production of bevel gears by unskilled labour, certain problems arise which require careful thought, if accurate and rapid manufacture of these components is to be ensured.

A figure indicates the ideal conditions of the blank for generating the teeth where the tip distance, the face angle ϕ and the back angle α are constant for the whole batch. Bevel gear blank set-up for the tooth-cutting operation. Dimensions of gear blank prior to cutting the teeth. The methods for mass-producing bevel gears are described which have been employed with a high degree of success when unskilled female labour only is available. The grinding of the face angle is done with a special equipment. Set-up for grinding the face angle on the blank. The desired face angle and tip distance are produced correctly within ± 0.0005 . "Go" and "not go" gauge for checking tip distance. It has been proved recently in practice that the extra operations fully justify their inclusion, and it will be agreed that when using unskilled labour the necessary precautions must be taken to ensure maximum output and accuracy.

The Production of Bronze Gear Blanks: Details of Recommended Foundry Practice, by E. Longden. (*Mst. Ind.*, London, January 10 and 17, 1941, Vol. 58, Part 2, 3, p. 26 and 54).

Practical aspects of moulding, gating and feeding of representative phosphor-bronze gear blanks, taking as examples designs cast in alloys:

Cu.	Sn.	P.
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88.3	11.5	0.2
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(Communicated by British Non-Ferrous Metals Research Association.)

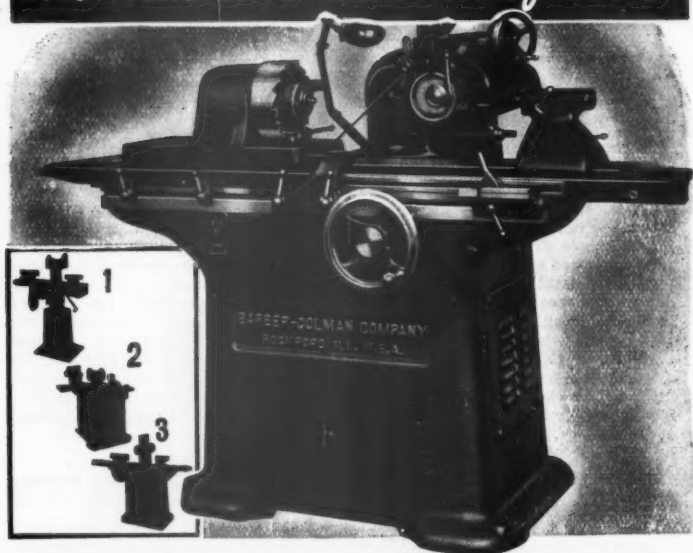
Alternative Design to Aid Production, by E. Stevan. (*Machine Shop Magazine*, February, 1941, Vol. 2, No. 2, p. 53, 5 figs.).

The choice of alternative materials is to-day greater than ever it was, and the possibility of using materials quite different from these normally utilised must not be ignored. In this connection the employment of plastics deserves very careful consideration. There is definitely a great need at the moment for the serious consideration of bringing component and unit design into line with the idea of facilitating production and assembly, of designing tools, dies, moulds and equipment, so that they can be made easily and by labour of a type readily available. Examples: Sand or die casting, pressings, etc., for (1) a machine tool shaft bearing pedestal; (2) small flanged elbow; (3) door knob; (4) sprocket and worm wheel; (5) fuse nose.

Curtiss Propeller Production, including the Hollow Steel Bladed Propeller (*Aviation*, U.S.A., Vol. 39, No. 10, October, 1940, p. 42 and 110).

Each blade is cut in two parts from steel plates tapering in thickness from $\frac{3}{8}$ in. to approximately $\frac{1}{16}$ in. One section forms the curved part of the blade and the shank, the other forms the flat or thrust face of the blade. After

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shaping by means of forming dies the sections are welded together by the atomic hydrogen method. The welded product is immediately heated to 1,700°F. in the electric furnace to remove welding strains, the hub or shank end is turned and the blade is rough finished. Heat treatment at 1,650°F. and oil quenching are followed by three hours in an electric furnace at 1,000 to 1,100°F. The final physical properties are as follows: Elastic limit, 125,000 lb./sq. in.; ultimate strength, 138,000 to 145,000 lb./sq. in.; elongation, 12 to 15%; reduction of area, 57 to 62%.

The hollow construction makes it possible to obtain correct vertical and horizontal balance by application of metal within the blade.

(Communicated by the D.S.R., Ministry of Aircraft Production.)

Tools for Navy Turbine Blades. (*The Machinist*, February 8, 1941, Vol. 84, No. 51, p. 1016, 16 figs.).

Shops equipped only with standard machine tools can machine turbine blades by using special fixtures. The blades are made from corrosion-resisting steel stipulated in U.S. Navy Department Specification 46S12d as Class "a" material, heat-treated for machining in rectangular bars. A figure shows the 14 operations used at the New York Navy Yard for machining high-pressure turbine blades for a naval vessel. The remaining operations are grinding the root taper to finish size ± 0.000 in., sanding and polishing concave and convex sides of the blade, magnaflux test for flaws, nitric acid test the material, and inspect for size and rotor fit. Six perspective illustrations show the fixtures with the workpieces and the tools set up in milling machines. Another series of figures show the plan and the operation of machining the low pressure blades.

Tube Profiling, by A. Schofield. (*Machinery*, February 20, 1941, Vol. 57, No. 1480, p. 567, 5 figs.).

Special purpose machine for profiling the ends of tubes. A typical welded, tubular frame. Sectional view of spindle mounting on profiling machine. Form of profile cutter employed. A typical tube profiling jig.

The Manufacture of Diamond Impregnated Tools. (*Machinery*, February 20, 1941, Vol. 57, No. 1480, p. 561, 8 figs.).

Grinding wheels for cemented carbides, diamond impregnated saws and drills, and a hand lap made by Impregnated Diamond Products, Ltd. Equipment used for crushing and grading diamonds. Power-operated hammer for diamond crushing. Typical dies for the manufacture of impregnated diamond rings for grinding wheels. Hydraulic press and furnace used in the manufacture of diamond impregnated products. An impregnated diamond drill, and an example of work performed by it.

The Development of Assembly Processes, by J. L. Miller and H. E. Lardge. (*The Welding Industry*, February, 1941, Vol. IX, No. 1, p. 25, 7 figs.).

Process development laboratory. Link between scientist and works. The production engineer's problems. Control in repetition work. Welding aluminium. Choice of production methods: A toothed pinion may be made by the following methods: (a) turned from solid rod of the pinion diameter (b) turned from a forging or hot stamping; (c) made in two parts with a key in the shaft or with a squared hole in the pinion and a squared end on the shaft; (d) pinion pressed on to a plain spigot on the shaft and copper brazed. Discussion of advantages and disadvantages. Copper brazing in hydrogen. Heating methods. Suggested laboratory equipment.

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MATERIALS, MATERIAL TESTING.

Available Alloys, by L. J. Weber and J. T. Weinzierl. (*The Machinist*, February 1, 1941, Vol. 84, No. 50, p. 1001, 2 figs.).

Aluminium is one of the most workable of the common commercial metals. Whenever aluminium or any other metal is worked cold, strain hardening takes place. During the manipulation of the metal the tensile and yield strengths are increased and the elongation is lowered. How these mechanical properties vary for the various tempers in the different alloys is shown in a Table I which contains alloy and temper, ultimate strength (lb. per sq. in.), yield strength (lb. per sq. in.), elongation, per cent. in 2 in. ($\frac{1}{16}$ in. specimen) and Brinell hardness (500 kg., 10 mm. ball). There are two groups of alloys. The so-called common alloys are produced by cold working. In another type, known as heat-treatable alloys, the mechanical properties are increased by thermal treatments. Among these alloys are 17S and 24S, which are of the duralumin type. The most widely used heat-treated aluminium alloy is 17S. Both 17S and 24S form now the principal material used in airplane construction. Table II gives the nominal composition of aluminium alloys: Cu Si Mn Mg Cr.

The Marine Use of Aluminium, by A. C. Hardy. (*Sheet Metal Industries*, February, 1941, Vol. 15, No. 166, p. 197, 2 figs.).

Notes on the present position of aluminium at sea, with an examination of the difficulties in the way of its general use. Virtues of the metal. Some superstructure designs. Strength of superstructure. Weldability. Super work hardened alloys. Pure aluminium coating. Riveting. The transatlantic liner of the future. Use in tankers. Shipbuilders are aluminium-conscious and will use the metal and its many alloys if (a) the result shows an undeniable saving in displacement, which is exemplified in the case of aluminium boats and superstructure on a large passenger liner; (b) a gain in capacity results, due to a saving in weight; (c) there is a gain in safety due to the elimination of fire hazard; (d) there are navigational advantages, but all at a reasonable price and in a form which will appeal to shipbuilders and shipyard workers alike.


MEASURING METHODS, APPARATUS.

Aircraft Interchangeability, by A. Schofield. (*Machinery*, February 13, 1941, Vol. 57, No. 1479, p. 533, 8 figs.).

The object of this article is to state the essential requirements for interchangeability of aircraft components and spares, and explain how they are obtained. A typical design office data sheet for an Aileron. Checking methods used: (1) Gauges used to check the actual components. (2) Jig references supplied for checking the jigs, and not the components. (3) Drill references supplied for actually drilling the jigs used to produce the components. (4) Jig reference equipment supplied for checking the jigs both optically and mechanically. (5) Sample jig-produced parts supplied as standards, and marked with red lines to indicate that they are "pattern" parts. An application drawing for a rudder gauge. A jig reference applied to an assembly jig. A drill reference applied to a works jig. Aileron gauge built-up from steel tubing and iron castings. Jig with welded mild steel frame.

METALLURGY OF STEEL.

Some Characteristics of Metal Surfaces, by E. A. Smith, F.C.S. (*Machinery*, February 13, 1941, Vol. 57, No. 1479, p. 541, 8 figs.).



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PRODUCTION ENGINEERING ABSTRACTS

The crystalline structure of surface materials. Beilby layer. Lubrication. Surface energies of faces. Fretage corrosion.

PSYCHOLOGICAL INVESTIGATION.

Tests for the Selection of Office Employees, by Millicent Pond. (*Personnel*, February, 1941, Vol. 17, No. 3, p. 199).

Significant progress has been made of late years in the use of clerical ability and aptitude tests. Among pioneers in this field is the Scovill Manufacturing Company. Effect of technology. Increased complexity of clerical tasks. Centralization and specialization. Selection problems at Scovill. General intelligence test. Validation process. Minimum score established. Typing and shorthand tests. Opportunities for research. Personality tests.

SHOP AND SHOP MANAGEMENT.

Industrial Training Programmes for Increased Production. (*American Management Association*, No. 126, November 12, 1940, pp. 3-5, 13, 18, 24).

Introduction, by *Albert Sobey*, director General Motors Institute. First we should recognize that training within industry is a responsibility of individual companies. The nature of the training required and how best given, will vary from plant to plant. Second, we should differentiate carefully between the training of operators in short, intensive courses and the trade apprentice training. In one case we are dealing with the training for specialized skills, largely, of course, for production workers. In the other case we are dealing with the well-rounded skill training for the skilled crafts. Third, there are different types of training required, even in the field of training semi-skilled operators for specialized jobs. Fourth, the proper training of new supervisors, and the training of supervisors and instructors in how to train operators is a matter of first importance. Fifth, there are restrictive factors that enter into the problem of training. These vary from industry to industry. It is well to check and consider these restrictive factors carefully. Sixth, it will be necessary to apply the same type of thinking and planning and industrial brain-power to the solution of this problem that we apply to industrial problems in engineering and manufacturing. Then follow four applications of these rules in the American industry: (1) The Warner and Swasey-Learner Training Programme, by *Ray J. Blyth*, Personal Director. (2) Emergency training at the Bethlehem Steel Company, by *A. M. Ruppkey*, Manager of Training. (3) Training of New Employees, by *H. A. Huffman*, Assistant General Superintendent, Arrowhead Plant, Armstrong Cork Company. (4) Apprenticeship's Contribution to Production for National Defence, by *William F. Patterson*, Chief of Apprenticeship, Division of Labour Standards, United States Department of Labour.

Company Problems of Multiple Shift Operation. (*American Management Association*, No. 125, November 12, 1940, pp. 3, 7, 17, 22, 33).

The pamphlet contains four articles on multiple-shift operations of: (1) Scovill Manufacturing Company, by *Alan C. Curtiss*; (2) Armstrong Cork Company, by *Henry V. Oberg*; (3) Kearney & Trecker Corporation, by *C. R. Hockmuth*; (4) Merck & Co., Inc., by *H. W. Johnstone*; and a fifth article on controlling scrap and repair during expansion by *W. H. West*. (1) Mr. Curtiss gathered his first experience in the Navy, which takes twenty-four-hour operation as a matter of course. In the private Scovill Manufacturing Co., Waterbury, the power-house, the watchman force and the casting shop work on a 24-hour basis. The author describes: rotating shifts,

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apprentices on two shifts, women's hours regulated by law, and the difficulties with skilled craftsmen. (2) Mr. Oberg is Industrial Engineer for 13 domestic operating plants of the Armstrong Cork Company. He divides the problem into (1) supervisory organization, (2) scheduling of personnel, (3) operation of the maintenance department (an interesting discussion is attached), (3) Kearney & Trecker build exclusively a particular type of milling machine. Their production three years ago was one-third of what it is to-day. The author gives a review of (1) foreman in charge of three shifts; (2) setting up the shifts; (3) inspection for quality and maintenance; (4) control of production; (5) operators for new machines. Discussion attached. (4) The problem of Merck & Co. was to increase production 300% or more without additional equipment. The actual shift schedule is shown for four shift crews, one working six days, three working five days. Three shifts of eight hours each were set up as follows: Shift 1 from 12 midnight to 8 a.m. Shift 2 from 8 a.m. to 4 p.m. Shift 3 from 4 p.m. to 12 midnight. (5) Thompson Products, Inc., make more than 2,000 types of aircraft valves, parts and fuel pumps. They have expanded from 1,590 workers to 3960 in 1940. The factory manager gives a brief review of the difficulties; loss of control; what was done about inexperienced help; learner's programme; tool deficiencies corrected; card system used; causes of rejections studied; customer's inspectors at plant; shift supervision overlapped.

Let's Recognize the Foreman, by Anonymous. (*Personnel, February, 1941, Vol. 17, No. 3, p. 192*).

The author who is the plant personnel manager in a company in the mass-production field, asks whether management is doing its share to equip the foreman for his responsibility. Is the differential right, he enquires, between the foreman's pay and that of the men he supervises? Is he given authority consistent with his responsibility? Does management try to "build up" the prestige of his job? The article tries to give the foreman's slant on these questions.

The Validity and Reliability of Ratings, by Randolph S. Driver. (*Personnel, February, 1941, Vol. 17, No. 3, p. 185*).

Despite recent refinements in the techniques of merit rating, no wholly objective method of appraising employees has yet been devised. Nevertheless, a number of methods of validating ratings have been used more or less successfully by investigators in this field. The author considers here the value and limitations of methods of validation in current use, and discusses also the problem of determining the consistency of ratings.

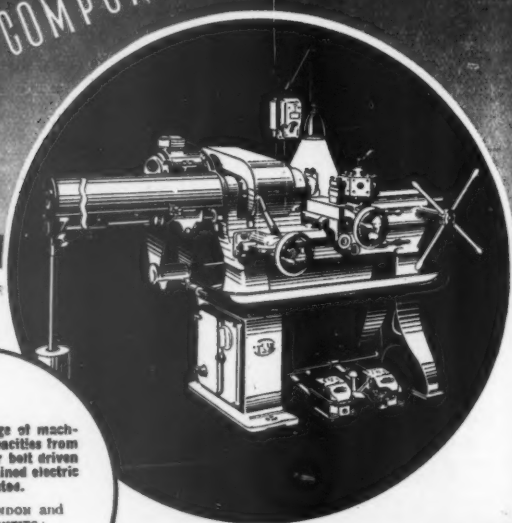
SMALL TOOLS.

Single-point Cutting Tools—17, by W. H. Tremewan. (*Practical Engineering, February 15, 1941, Vol. 3, No. 56, p. 104, 2 figs.*).

Selection of grinding wheels. The makers of the carbide tips are themselves anxious to give advice on this matter. The surface speeds are much the same as for steel grinding, and take the value of about 5,000 surface feet per minute. Some manufacturers strongly recommend the use of a coolant, while others advocate dry grinding. Machines for the purpose under review are usually arranged to give a copious supply of water and, if so used, many benefits accrue, finer finishes are produced for a given grit size and harder grades of wheels may be used and no risks run. The introduction of the diamond wheel will show that a still higher plane is reached in the maintenance of cemented carbide cutting tools. Wheels are available in the usual forms and shapes,



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and all general requirements can be met without undue difficulties. Diamond concentration. Grit sizes. Grinding procedure with diamond wheels. Wheels recommended for single-point tools, off-hand grinding. The application of water by a brush keeping the surface constantly moist is considered satisfactory.

How to Use Truing Tools, by H. J. Wills. (*The Machinist*, February 22, 1941, Vol. 84, No. 53, p. 963, 7 figs.).

The forming of fillets and convex or concave surfaces on the face of a grinding wheel requires considerable care in the selection and operation of tools. A precision radius truing fixture must be used, when the face of a grinding wheel is given a precise convex or concave radius. A "drop" shaped expensive diamond is needed for truing sharp corners. An ordinary stone can be mounted in an offset adapter for truing sharp corners. A special adapter permits setting the diamond in two positions.

How to Use Ardoloy. (*Machine Tool Review*, September-December, 1940, Vol. 28, No. 176, p. 153, 10 figs.).

Necessary working conditions, condition of cutting edge of tool, grinding instructions, diamond wheels and their use.

Tool Compositions of Cemented Hard Carbide: Their Properties and Industrial Application, by P. M. McKenna. (*Powder Metallurgy Conference, Massachusetts Inst. Tech.*, 1940, p. 116).

This deals in the main with cutting tools based on the use of the inter-metallic compound $WTiC_2$, but is also of interest from the point of view of hard carbide cutting tools in general.

(Communicated by *British Non-Ferrous Metals Res. Assoc.*)

STANDARDIZATION.

Standards of Accuracy for Engine Lathes—I. (*The Machinist*, February 15, 1941, Vol. 84, No. 52, p. 985, 12 figs.).

Standards of accuracy were drawn up and adopted by the builders of engine lathes, members of the National Machine Tool Builders' Association U.S.A. The standards give tolerances to which the industry is building toolroom and engine lathes, and tests by which the tolerances may be checked. Twelve tests—illustrated in a very similar way as the acceptance test charts of the Institution of Production Engineers and Mechanical Engineers—are prescribed. The recommended standard refers to (1) toolroom lathes, (2) 12 to 18 in. engine lathes, (3) 20 to 36 in. engine lathes. The admissible tolerances correspond very nearly to the proposed British standards.

SURFACE, SURFACE TREATMENT.

The Tinning of Piston Rings. (*Engineering*, Vol. 150, No. 3906, November 22, 1940, p. 410).

The piston rings are ground accurately to size, making an allowance for the thickness of the tin deposit which is subsequently applied. As a result of the grinding operation, the periphery of the ring has a surface composed mainly of disturbed and flowed material, which would be liable to become detached and cause wear in service. In the next operation any grease present on the rings is removed in a hot alkaline bath, and they are then etched in an acid bath. The etching treatment frees the surface from loosely adherent

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and smeared material left by the grinding operation and leaves a pitted surface consisting of small hollows or depressions. The rings are then washed thoroughly and given a coating of 0.0005 in. (0.012 mm.) of pure tin in an electro-tinning bath of the alkaline-stannate type. After final washing and drying the rings are ready for use.

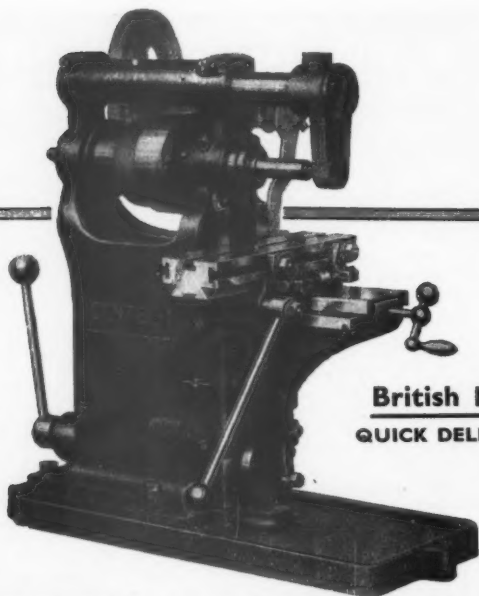
It is stated that the pitted structure of the tinned surface possesses a number of advantages. In the first place it assists in retaining the lubricating oil on the ring during the formation of the Beilby layer. Furthermore, the coating of tin is sufficiently plastic to flow at the points of greatest pressure and thus prevents scoring while the surfaces are running in and the Beilby layer is being formed. It is emphasised that the combination of a hard network of iron phosphide, present on the surface, with plastic pure tin resembles ordinary bearing metals in which relatively hard particles are embedded in a softer matrix.

How Should Engineers Describe a Surface? by O. R. Schurig. (*Mechanical Engineering*, Vol. 62, No. 10, October, 1940, p. 703).

The geometrical characteristics of a surface profile are so numerous that the shape of a surface cannot be adequately described by a single parameter of its profile. The following geometrical characteristics have been suggested or considered in connection with the description of a surface: (1) Maximum height from highest to lowest point. (2) Average height above base line passing through lowest point. (3) Form factor, being the ratio of average height to maximum height above baseline. (4) Root-mean-square average height with respect to centre line of profile. (5) Prevailing wave length. (6) Direction of irregularities above or below the prevailing surface contour. (7) Direction of finish marks with respect to co-ordinates of the surface. (8) Available contact area per unit nominal area. Efforts should be concentrated to determine what geometrical qualities are important for surfaces used in different kinds of applications and in different industries. Once the significant qualities have been agreed on they should be used as a basis for standards covering the description and designation of surface quality. The standards should provide adequately for describing waviness, roughness and surface flaws. A designation of surface qualities including reference to a process of finishing may be useful in giving instructions in the shop, but the purpose of the standard is not to specify how the surface shall be made, but how it shall be described.

Automatic Electro-plating, by A. G. Allen. (*Machine Shop Magazine*, February, 1941, Vol. 2, No. 2, p. 66, 7 figs.).

Automatics for all bright finishes. Twin plant for depositing bright nickel and chromium on die castings and steel components. Automatic nickel-plating plant. The conveyor gear is a steel frame upon which two slowly moving conveyor chains on both sides of each plant run the full length of the plant and convey the work-bars through the various processes at the speed required to give the necessary immersion time in the cleaning and plating tanks. The processes are (I) *For die-cast parts*: (1) Electric cleaner, (2) hot swill, (3) acid dip, (4) cold swill, (5) cyanide dip, (6) cyanide copper, (7) cold swill, (8) cream of tartar, (9) cold swill, (10) nickel plate, (11) cold swill, (12) warm swill, (13) chrome plate, (14) drag out, (15) cold swill, (16) neutraliser, (17) cold swill, (18) hot oven, (19) drying oven. (II) *For steel parts*: (1) Electric cleaner, (2) hot swill, (3) acid etch, (4) cold swill, (5) cold swill, (6) nickel plate, (7) cold swill, (8) warm swill, (9) chrome plate, (10) drag out, (11) cold swill, (12) neutraliser, (13) cold swill, (14) hot swill, (15) drying oven. Keeping solutions clean. Nickel-plating tanks. Chrome-plating tanks. Filtration of solutions. The electrical equipment. "Rotomatic" plant. Articles are suspended from hooks, and heating, filtering and agitating devices are incorporated. Plating barrel with stoneware plating tank and swill.



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PRODUCTION ENGINEERING ABSTRACTS

WELDING, BRAZING, SOLDERING.

Welding in the Construction of Machine Tools. (*Industrial Power and Fuel Economist, January, 1941, Vol. XVII, No. 134, p. 10, 8 figs.*).

Draughtsmen who have grown up with the growth of welding are beginning to show that the cast-iron technique is out of date. Fabrication allows the use of material of greater overall strength and equally strong in tension and compression. The result is a lighter, stronger and less bulky job constructed more quickly and more easily to a time table. The prevalence of the "draw" instead of the "push" cut in machine tools is largely a recognition of the weakness in cast-iron structures. Examples: (1) Welded brackets with deep pockets and expensive coring; (2) a light gear box of $\frac{3}{4}$ in. plate with facings and bosses welded on including a self-contained buffer to carry a flange-mounted electric motor; (3) steel beams and levers, light yet rigid, which required no patterns and represent a good example of one-piece construction, doing away with bolts or rivets; (4) a welded steel punching head which, though not saving much weight, is as stiff and strong as a steel casting costing twice as much; (5) a welded steel bed for a reaming machine with an integral chip and lubricant guard, unbreakable, though of thin section; (6) two housings which withstand the severe loads imposed by the rolls when bending plates up to 20 ft. wide and $1\frac{1}{4}$ in. thick; (7) a 14-ft. diameter steel table welded for convenience in two halves, each weighing 9 tons; (8) a frame for a 360 ton bending and straightening press handling bars up to 10 in. diameter and breaking rounds up to 8 in. diameter or squares up to 7 in. shows how welding overcomes the problems of increasing loads in modern machine tools.

Pipe Welding Work, by J. K. Johannesen. (*The Welding Industry, February, 1941, Vol. IX, No. 1, p. 14, 5 figs.*).

In Great Britain pipe welding has been confined to works installations such as gas-products plant, power station equipment, and oil storage systems, and there has been no opportunity or necessity for developing on the transatlantic scale. Generally speaking, pipe work calls for probably the highest degree of operative skill obtainable in the welding industry. Particularly is this true of high-pressure and temperature rise conditions such as one encounters in power station work. Examples: (1) A steam coil installation in a pitch processing tank at a North of England gas by-products plant. (2) The layout of one of the first all-welded feed trunking systems for a marine boiler installation. Some 70 flanges each 10 or 11 in. bore were welded; about 14 branch pieces and some 20 butt welds made in the ducting.

New All-Welded Factory in the United States. (*The Welding Industry, February, 1941, Vol. IX, No. 1, p. 17, 2 figs.*).

A new all-welded factory has recently been erected for the Le Tourneau Company in U.S.A. This factory involved the use of 5,500 tons of steel and the design utilized a special fabricated steel panel. This panel construction provides self-supporting roofs and is an interesting development in all-welded structures. Exterior view of office building during early stages of construction.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

BELTS, ROPES.

The V-Rope Drive, by H. Stuart Jude. (*Power Transmission*, March, 1941, Vol. 10, No. 110, p. 65, 3 figs.).

The basic details which influence the ability of a V-rope drive to transmit power are : (1) The pulling power per rope at 1,000 ft. per minute rope speed. (2) The number of ropes. (3) The rope speed. (4) The loss of power due to the arc of contact falling below 180°. Designing a new drive: Find the drive ratio. Find the maximum horse-power it may be required to transmit. We must make allowance for every loss of power by adding the compensating driving strength in the ropes. The correct position of V-ropes in the grooves. In each case a simple division sum is necessary to find the number of ropes required for transmitting the power, if the speed of the ropes is calculated. The rope length must now be decided. We employ the formula—

$$\text{Rope length} = 2L + 1.57 (D+d) + \frac{(D-d)^2}{4L}$$

where D = the larger pitch diameter in inches, d = the smaller pitch diameter in inches, L = the centre distance in inches. In the interest of long life, V-ropes ought always to be placed on the drive without the slightest forcing, and the tension applied gently, whilst the drive is actually running.

EMPLOYEES, WORKMEN.

The Utilisation and Training of Labour under War Conditions, by B. C. Jenkins. (*Machine Shop Magazine*, March, 1941, Vol. 2, No. 3, p. 74).

Skilled labour position prior to outbreak of war. Statement of labour supply problem. Necessity for planned utilisation of labour. Introduction and training of unskilled labour. Upgrading semi-skilled labour. Upgrading to meet toolroom requirements. Planned progression of labour. Conditions affecting utilisation of labour. Labour supply organisation—Ministry of Labour. Drive home the urgent need for accurate planning with a view to conservation of skilled labour to everyone concerned from operative labour up to the managing director.

HEATING AND VENTILATION.

Warming and Ventilating Air-raid Shelters, by Louis J. Overton. (*The Heating and Ventilating Engineer*, March, 1941, Vol. XIV, No. 165, p. 344, 5 figs.).

Air-raid shelter warmed by branch circulation from a forced circulation hot-water system. Air-raid shelter warmed by forced circulation from a hot-

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water gravity system. Surface air-raid shelter showing ventilating hoppers. Underground air-raid shelter showing ventilating tubes. Air-raid shelter provided with air filter and pressure ventilating apparatus.

JIGS AND FIXTURES.

Design of Aircraft Assembly Fixtures, by A. Schofield. (*Machinery*, March 27 1941, Vol. 57, No. 1485, p. 701, 10 figs.).

A typical aircraft structure divided into its main assembly units. A typical fuselage assembly fixture. An outer wing assembly fixture. Method of locating the inboard ends of the spars. Method of reaming the holes in the root ends of the spars to finished size while the assembly is in the fixture. Method of mounting fixtures on base castings grouted to the floor. Assembly fixture for wing trailing edge. Aileron assembly fixture. Detachable nose assembly fixture. Assembly fixture for engine mounting frame.

MACHINE ELEMENTS.

Bearing Clearance, Surface Quality, Friction and Oil Leakage, by R. G. Pomeroy. (*Mechanical World*, Part I, March 7, 1941, Vol. CIX, No. 2827, p. 166, 4 figs.). (Part II, March 14, 1941, Vol. CIX, No. 2828, p. 185, 4 figs.).

The problem which will be considered is that of a 4-in. dia. by 8 in. wide bearing supporting a shaft running at 1,000 r.p.m. and carrying a total load W. of 6,400 lb. The factor of safety, running temperatures and power loss will be calculated for seven different oils. Diametral clearance. Surface irregularities and minimum film thickness. Positions of journal running unloaded and loaded. Eccentricity and Sommerfeld's variable. Coefficient of friction. Side or end leakage. Relation of coefficient of friction to viscosity, speed and pressure for bearings. Graph relating to running temperature, power loss and viscosity of oil, and containing viscosity scale conversion. Factor of safety, power loss and Saybolt viscosity at 100°F. for a bearing running under assumed conditions.

CHIPLESS MACHINING.

Chambersburg Drop Hammers for Heavy Forging. (*Machine-Tool Review*, September-December, 1940, Vol. 28, No. 176, p. 164, 6 figs.).

Line of drawing of the Chambersburg 35,000 lb. hammer, showing the pit over 31 ft. deep, and the foundations necessary for installation. Chambersburg 20,000-lb. steam drop hammer producing large crankshaft forgings. Valve operation on Chambersburg hammers.

"Can" is a Victory Word, by W. E. Hoare. (*Sheet Metal Industries*, March 1941, Vol. 15, No. 167, p. 329, 13 figs.).

How canners and can-makers are safeguarding essential war commodities. Control. Prefinished tinplate. Technical considerations. Food, Processing. Coatings and decoration. A semi-automatic round can double seamer. Two-colour tinplate decorating press. Exterior corrosion. Lacquering. Filming treatment. Strength. Composite containers. Autoclave with pressure-cooling device.

Drawn Shapes, by L. J. Weber and J. T. Weinzierl. (*The Machinist*, March 29, 1941, Vol. 85, No. 1, p. 8, 6 figs.).

Allowance must be made for the work hardening of aluminium and its alloys during cold drawing. Typical first and second operation of shells, together

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with the developed blank for an aluminium pan. Flow of metal is drawn for cylindrical shells and is indicated by lines scribed on the blanks. Where a hemispherical shape is to be formed in two draws it is important that the shell formed in the first draw have sufficient metal at proper positions. Table of capacity of presses used for drawing various blanks. Table of reduction in diameter for deep shells. Die dimensions for drawing rectangular shapes. Die dimensions for drawing cylindrical shapes. Effect of on mechanical drawing properties.

MANUFACTURING METHODS.

Aircrew Assembly. (*Aircraft Production*, March, 1941, Vol. III, No. 29, p. 90, 14 figs.).

Blade assembly operations. Horizontal balancing of the blade with lead wool. Final balancing of the assembled aircrew. Drilling the four dowel pin holes in a metal blade. The commencement of final aircrew assembly. Fitting the bearing housing and ball race assembly. Centralising the pitch-changing actuating link.

Producing the "Shadow" Blenheim, by Bruce Foster. (*Aircraft Production*, March, 1941, Vol. III, No. 29, p. 79, 13 figs.).

Part III.—Assembly processes in the main erecting hall; final adjustments and flight tests.

Vickers' "Wellesley" and "Wellington," by F. Beach. (*Sheet Metal Industries*, March, 1941, Vol. 15, No. 167, p. 372, 12 figs.).

Fuselage construction of the Vickers "Wellesley," comprising four tubular longerons and built-up diagonal members. A portion of the built-up tubular member used for spar bracing posts. A typical geodetic panel used for covering the wing. A "Wellington" fuselage top decking in its assembly jig. A "Wellington" outer wing prior to covering with fabric.

Mass Production of Tank Wheels, by A. M. McFarland. (*The Welding Industry*, March, 1941, Vol. IX, No. 2, p. 31, 5 figs.).

Layout for quantities. Automatic welding wire. Indented wire. Ground connection. Butt seams. Manipulation technique. Welding of spoke ribs.

Thinner Babbitt Linings in the 1941 Models, by J. Geschelin. (*Automotive Ind.*, January 1, 1941, Vol. 84, No. 1, p. 23).

A majority of the 1941 American passenger cars are fitted with steel-backed engine bearings (some with an inter-lining) having a babbitt thickness 0.002—0.005 in., as contrasted with the formerly generally accepted 0.015—0.025 in. This is claimed to reduce fatigue to such an extent that bearing life is doubled or trebled. The paper includes notes on other bearing metals used in the 1941 cars.

MATERIALS, MATERIAL TESTING.

The Manufacture and Use of Cemented Carbides, by H. Burden. I and II. (*Engineering*, January 31, 1941, Vol. 151, No. 3916, p. 86, 5 figs. February 21, 1941, Vol. 151, No. 3919, p. 145, 11 figs.).

Part I.—The first hard metals, containing tungsten carbide and cobalt, are still most generally used, and constitute the bulk of the commercially

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produced hard metals. While a number of other metals, such as tantalum and titanium, are employed, they are used chiefly in small percentages as addition elements to the tungsten carbide-cobalt hard metals.

There are two methods of manufacture—the cold-press and the hot-press processes. The latter, however, is no longer used, the cold-press method being that almost universally adopted. The pressing is done in hardened steel dies at pressures which vary considerably from as little as 3 tons to as much as 100 tons per square inch. An intensely hard one and a soft ductile metal are present. We can consider these two to be tungsten carbide, on the one hand, and cobalt on the other. The structure of a cemented carbide consists of hard particles bonded together in a matrix of cobalt. On heating the mixture of cobalt and tungsten-carbide powders, some limited diffusion takes place with the formulation of solid solutions. Finally the remaining liquid solidifies at the eutectic temperature to form the matrix which bonds the hard particles together. The view popularly held is that the hot steel cutting, as it passes over the upper face of the tool, actually welds on to individual grains of carbide. This results in the removal of a succession of particles, which soon leads to the development of a cavity. This explanation also accounts for the fact that the cutting edge of the tools remain unmarked while the cavity is growing. The carbide is used in the form of tips brazed on to carbon-steel shanks, with copper, spelter, silver solder or similar compounds. The most economical method of reconditioning tools which have not been very badly damaged is by the use of a diamond wheel. It is only when a badly chipped or broken tool has to be reground that the coarse silicon-carbide grinding wheel offers any advantage over the diamond. The successful application of carbide alloys depends almost entirely on the correct selection of the type of carbide for the work required. The hardness on the diamond scale varies from about 1,300 for the soft, tough alloys, containing large percentages of cobalt, to about 1,700 for the harder alloys.

Part II.—The next consideration is one of tool form. There are roughly speaking two types of chip or swarf which may form when metal is cut, (1) the segmented chip which is obtained when machining cast iron, (2) the second type of chip is the continuous type found in the machining of steel, copper and some aluminium alloys. For the rough machining of steel top rakes of 3° to 8° are sufficient. For machining of aluminium and copper top rakes of 15° to 30° are employed. The clearance angle from 6° to 8° and quite often 4° are sufficient and give excellent results. Sharp corners on the tool form should be avoided if possible. Carbides tool will work on any machine which is maintained in a reasonable good condition, and has ample power for the work which the tool will be expected to do. Examples of modern practice shown by figures. Machining manganese steel pump compeller. Machining alloy steel rough forging. Machining small alloy-steel forging. Turning carbon steel at 3,000 r.p.m.

Aluminium Casting Alloys for Internal Combustion Engines. (*Engineering, Vol. 151, No. 3917, February 7, 1941, p. 120*).

Two publications issued by Messrs. Aluminium Union, Ltd., describe recent developments in Al-alloys for internal combustion engines. These include a piston alloy containing 10% Cu. with small additions of Fe and Mg. It is easier to machine and cheaper than the material previously used, containing 4% Cu, 2% Ni, and 1.5% Mg. Both alloys are used in the heat-treated condition and are stable and mechanically strong at temperatures up to 400°C . Amongst the corrosion-resistant magnesium-aluminium casting alloys, one containing 1% Mg. is amenable to heat treatment and is suitable for sand and gravity die castings of simpler forms. An alloy containing 4% Mg. is employed

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in the as-cast condition for carburettor bodies. There is now a tendency to replace the wrought components of internal combustion engines by castings in alloys giving the required mechanical properties. An example is an alloy containing 4.5% Cu. up to 0.9% Si, up to 0.7% Fe, and 0.25% Ti, which after heat treatment has an ultimate tensile strength of 26 tons/sq. in.

Magnesium Alloys in Industry, by J. C. Mathes. (*Metals and Alloys*, January, 1941, Vol. 13, No. 1, p. 23).

Uses for reducing weight (tools, core boxes, structural shapes, dockboards for loading goods-wagons, etc.) are discussed. Reference is also made to good machining properties of Magnesium alloys.

Tin in the Federated Malay States. (*Met. Ind. (Lond.)*, Tin Research Institute, February 7, 1941, Vol. 58, No. 6, p. 142).

Geology; history; methods of extraction and smelting; statistics.

Identification of Light Scrap. (*Engineer*, Vol. 171, No. 4442, February 28, 1941, p. 145).

Three solutions are recommended as sufficient to identify the light metal alloys when in scrap form: No. 1, 30 per cent nitric acid solution in water; No. 2, 20 per cent. caustic soda solution, and No. 3, 5 per cent hydrochloric acid solution in water. Solution No. 1 produces a positive reaction only with magnesium base alloys of the Elektron type. A drop of this solution placed on a perfectly clean surface of such alloy will produce a pronounced white colouration after a few minutes. This test is quite suitable for the identification of magnesium base alloy scrap. The alloys aluminium-silicon and aluminium-magnesium-silicon are indicated by a greyish-brown colouration with No. 2 solution. Pure aluminium is indicated when no etching reaction is obtained with Nos. 1 and 3 solutions. If a drop of No. 2 solution produces a black stain, the alloys containing copper (aluminium-copper and aluminium copper-Zinc) are indicated. If on wiping off the remaining caustic soda solution a drop of No. 3 solution removes the black stain, the scrap tested belongs to the group aluminium-copper-zinc.

Substitute Materials and the War Effort, by H. Lilley. (*Machine Shop Magazine*, March 1941, Vol. 2, No. 3, p. 59, 3 figs.).

Some years before the war the writer experimented with a number of hard woods impregnated with molten paraffin wax with the object of using the material for the manufacture of jigs and fixtures for small quantity production. The most satisfactory wood was found to be Spanish mahogany. Beech was also tried and for some tools proved equally satisfactory. The method employed was to use two layers with the grain in opposite direction, glued together under pressure, dowelled and screwed. Sandwich type drill jigs for the drilling of small irregular shaped components. A milling fixture constructed from wood. A wooden drilling jig for the milled component.

MEASURING METHODS.

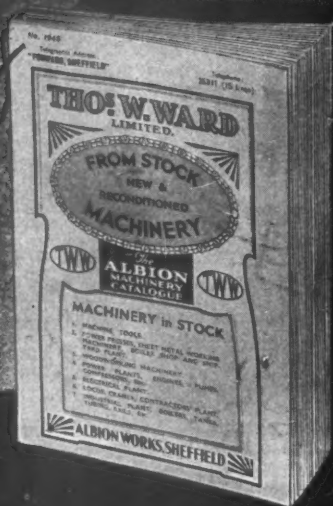
Use of Dial Indicators on Special Gauges, by L. H. Leedham. (*Machinery*, March 13, 1941, Vol. 57, No. 1483, p. 658, 4 figs.).

A simple indicating gauge for checking the throw of an eccentric. Checking an angular bore. Indicating gauge for checking holes in work flanges for parallelism and radial and angular position.

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Four New British Precision Measuring Instruments. (*Industrial Power and Fuel Economist*, February, 1941, Vol. 17, No. 185, p. 19, 7 figs.).

The Newall optical circular table. The Sigma comparator. Optical flats. The O.M.T. Omtimeter.

Measuring Small Diameters in Die Holes and Fine Wires. (*Industrial Diamond Review*, January, 1941, No. 2, p. 10, 8 figs.).

Direct methods. Application of the conical needle gauge giving correct reading. Principle of measurement with the wire gauge. Indirect measuring methods.

Contour Measurements. (*Industrial Diamond Review*, January, 1941, No. 2, p. 7, 7 figs.).

One of the difficulties in the production of dies of all kinds lies in the impossibility of exactly measuring the shape of the entrance or approach. Microphoto of diamond die in semi finished state. Microphoto of diamond die completed. Microphoto of a sintered carbide die cut to give a sectional view. Steps followed in measuring approach angle. Outlining the bearing zone.

Tool Dynamometer for Measuring Rapid Force Fluctuations, by Ronald N. Arnold. (*Engineering*, March 21, 1941, Vol. 151, No. 3923, p. 221, 11 figs.).

The problem confronting the author was that of recording extremely rapid force fluctuations such as exist under "chatter" and intermittent cutting. Three guiding principles controlled the design, namely: (1) The strain-recording mechanism should be capable of recording frequencies of the order of 5,000 cycles per second. (2) The dynamometer masses should be arranged to give as high a natural frequency as possible without prejudicing strength and accuracy of strain measurement. (3) Errors due to secondary strains arising from the interaction of the component forces should be limited to 5 per cent. Force records (Depth of cut, feed, cutting speed). Strain records with "chatter" (Depth of cut, feed, cutting speed, vibration frequency).

PLASTIC MATERIAL.

Transparent Coverings. (*Aircraft Production*, March, 1941, Vol. III, No. 29, p. 77, 8 figs.).

Plastic materials possess a number of advantages over glass, among which may be mentioned a lower specific gravity, a higher efficiency in transmitting light and the property of being readily moulded when heated to two or three-dimensional shapes which can be made to conform to the external shape of the aircraft. A Plexiglas turret and blister on a four-engined Boeing bomber. The transparent housing of the radio loop aerial on the nose of a Lockheed 14 transport. The transparent cockpit cover of a Harvard trainer.

Chromium Plating of Nickel-Chromium Steel Plastic Moulds, by A. Logozzo. ("Hard Plating Plastic Moulds" *Proc. Amer. Electroplaters' Soc.*, 28th Annual Convention, 1940, p. 146).

Four major problems involved in moulding of plastics may be alleviated by the use of chromium-plated moulds:—(1) wear, (2) sticking and fouling of the compounds used (binders, fillers, plasticisers, etc.). (3) attack by corrosive agents present in the plastics, and (4) pitting, due in part to reaction gases formed during the moulding cycle. Requirements for chromium-plating of

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SHOP MANAGEMENT.

How to Avoid Tool Shortage, by David Cameron. (*The Tool Engineer*, February, 1941, Vol. X, No. 2, p. 64, 2 figs.).

Inventory and activity cards, and turnover report. Gone is the guesswork. Crib control in use. Handling tool orders. Tools kept sharp. Location indexed. Keeping breakage down.

SMALL TOOLS.

The Care of Broaching Tools. (*The Machinist*, March 29, 1941, Vol. 85 No. 1, p. 1, 5 figs.).

No broaching operation can be successful unless the broach is kept in good condition. Here are some pointers that will help keep these tools in good shape. Right and wrong methods of sharpening. Dimensions for round and spline broaches.

Tool Life in Metal Turning, by George M. Class. (*The Machinist*, March 15, 1941, Vol. 84, No. 56, p. 1055, 3 figs.).

Cutting speeds which result in 4-hr. life of single-point tools can be calculated by using simple formula. Tool overhang must be kept at a minimum, with the cutting edge in proper relation with the work. Suggested cutting speeds for turning tools.

STANDARDISATION.

Standardisation in Aircraft Manufacture. (*Aircraft Production*, March, 1941, Vol. III, No. 29, p. 105, 6 figs.).

The fact that the modern total war is won not so much on the firing line as on the production line, was the theme at a recent S.A.E. National Aircraft Production meeting at which eminent engineers and production specialists discussed not only the urgency of standardisation, but how best such standardisation can be carried out. The accompanying notes review the main points of the papers and the discussion which followed.

TECHNICAL EDUCATION.

Training for National Defense. (*Mechanical Engineering*, March, 1941, Vol. 63, No. 3, p. 183, 1 fig.).

I. *The problem and how the Government is meeting it*, by A. A. Potter. Vocational training of less than college grade. Civilian-pilot-training programme. Training by the advisory commission to the Council of National Defense.

II. *Need for training on college and sub-college level as seen by U.S. Civil Service Commission*, by E. J. Stocking. Training at the college level. Need for machinists and machine operators. Need for other craftsmen. Possibility of upgrading. Role of Civil Service Commission.

III. *The Navy training programme for civilian employees*, by C. W. Fisher. Existing force and requirements—procurement. Training. Apprentice

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training. Artisans and helpers. Shop instructors. Supervisors. Naval architects. Engineers, and draftsmen. Inspectors. Acknowledgment.

IV. Training college graduates for the Aeronautics industry, by R. Randall Irwin and Jacob Kadushin. Need for specialised training. Training of men already employed in engineering department. Training of recent engineering graduates without industrial experience. Training of engineering graduates with experience in other industries. Courses given at Caltech (California Institute of Technology). Practical training at Lockheed factory.

V. The New York State Education Departments nation-defense training programme at Rensselaer Polytechnic Institute, by William Otis Hotchkiss and Stanley B. Wiltse. Preliminary canvass of local industries conducted. Registrations exceeded expectations. Instructors recruited from industry. What subjects are taught. Number and quality of the enrolled students.

TECHNICAL INFORMATION.

United States Machine Tool Exports. (*Machinery, March 20, 1941, Vol. 57, No. 1484, p. 697.*)

SEPTEMBER, 1940.

			Exports to United Kingdom		Exports to Canada.		Exports to The U.S.S.R.	
			No.	Value	No.	Value	No.	Value.
			\$		\$		\$	
Total	...	...	3,519	15,358,726	616	2,320,737	66	1,801,397

			Exports to Japan.		Total Exports.	
			No.	Value	No.	Value.
			\$		\$	
Total	...	...	71	585,143	4,813	21,327,287

WELDING.—

Foreign Rolling Stock Construction, by a Railway Engineer. (*The Welding Industry, March, 1941, Vol. IX, No. 2, p. 43, 7 figs.*).

Arc Welding on the Railways, II.—Main-line coaches in Holland. Comparison of riveted and welded details on the framework of a coal wagon. Norwegian railway workshops. Riveted underframe of a Norwegian freight car, versus welded underframe of a Norwegian freight car. An Italian streamlined train. Principles of design. The front end of the Italian Breda train.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

ANNEALING, CASE-HARDENING, TEMPERING.

Case Depths in Gear Manufacture, by D. McPherson. (*Machinery*, April 10, 1941, Vol. 58, No. 1487, p. 37, 7 figs.).

Thin depth . . . under 0.025 in. Medium . . . 0.025 to 0.060 in. Heavy . . . over 0.060 in. The medium case depth which, incidentally, is the most popular in gear manufacture may optionally be subdivided into medium 0.025 in. to 0.040 in. and medium heavy 0.040 in. to 0.060 in. Failure of spur gear to undercut and chamfer not blended into fillet. Stamping defect revealed by hot etching. Choice of steel. Cause of probable failure. Abrasion, shear stress, shock loading, alternating bend stresses, crushing loads or breaking up of the surface in the form of pitting. Failure of worm caused by overloading. Microstructure of cracked area. Pitting of gear teeth. Chipping of gear teeth. Cracks caused by faulty grinding. $3\frac{1}{2}\%$ Nickel case-hardening steel worm showing case flaked off by incorrect grinding. Fractures. Flaking caused by initial grinding cracks.

Design in Hardsurfacing, by M. Riddihough. (*The Welding Industry*, April, 1941, Vol. IX, No. 3, p. 60, 10 figs.).

The importance of hardsurfacing in these days when tools and equipment generally are subjected to constant wear need hardly be emphasised. A number of practical examples is given, showing how welded hardsurfaces can be efficiently applied so that the best results may be obtained. Cutting edges. Shear blades—hot. Shear blades—cold. Punches and dies. Conveyors. Valves and seats. Steam valves. Shafts and sleeves.

ACCOUNTING, ADMINISTRATION.

Problems of Accounting Responsibility. (*American Management Association, Financial Management Series*, No. 65, p. 3.).

Introduction, by Ernest F. Rumpf. Stages of management development. Management of 20 men. Introduction of mass production. The fight for the consumers' dollar. Present conditions. What the financial executive can do.

Procedure and Attitude Training, by E. F. Wonderlic. (*American Management Association, Personnel Series*, No. 47, p. 38.).

Importance in customer relations. Management organisation chart Application of principles in a job situation. I. The problem. II. Problem solution. Acceptable procedures (1) to the customer (2) to the employees (3) procedure that top management would accept, endorse and use. III. Teaching methods. IV. Continuous training.

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PRODUCTION ENGINEERING ABSTRACTS

Large Heat-treatment Installation for Forgings. (*The Machinist*, April 19, 1941, Vol. 85, No. 4, p. 28E, 4 figs.).

Layout of plant. Furnaces and charging machine. Quenching tanks.

EMPLOYEES, WORKMEN, APPRENTICES.

Trends in the Labour Movement, by Leo Wolman. (*American Management Association, Personnel Series*, No. 48, p. 9.).

Three influential forces. 1. Improved business conditions. 2. Public policy toward labour. 3. Position of trade unionism in U.S. Recent development. Total membership about eight millions. Organized labour's attitude. Effect of uneven expansion. Organizing devices. Consequences of present influences. Number of strikes. The number of strikes of 1940 will have been well over 2,000. But when strikes are measured by the number of man-days lost, 1940 was beyond doubt a quiet year. Upward movement of wages in prospect. Long-term consequences.

FOUNDRY, MOULDING.

Selection Chart for Die-Casting Alloys: Comparative Ratings from Specific Standpoints, by Anon. (*Metals and Alloys*, January, 1941, Vol. 13 No. 1, p. 58).

A table, prepared by die-casting authorities familiar with the use of all the alloys listed, rating common American die-casting alloys in their order of merit under 21 headings. The headings are mechanical and physical properties casting characteristics, costs (including die costs) and extent of present American use. Alloys considered are Al alloys A.S.T.M., Nos. 5, 7, 12; brass (no details); Mg. alloys, A.S.T.M., Nos. 12, 13; Zn alloys, A.S.T.M., Nos. 21, 23, 25.

(Communicated by British Non-Ferrous Metals Research Association.)

GEARING.

Master Gears, by Harry Walker. (*Machinery*, April 3, 1941, Vol. 58, No. 1486, p. 9, 4 figs.).

A description of a standard set of master gears and their uses in testing spur and helical gears during manufacture. The elements of a spur gear which are capable of being tested by means of a master gear are:—(1) Concentricity (2) Pitch and profile errors. (3) Tooth thickness. (4) Axial alignment of teeth. Gear set up for testing with a master on a Parkson machine. Advantages of individual testing of a gear pair. (a) Test chart for two eccentric gears in mesh. (b) Test chart for eccentric gear meshing with master. The Maag gear tooth comparator. Other uses of the master gears. Application to helical gears. Manufacture of the master gears.

HEATING, VENTILATION.

The Combustion of Waste-Wood Products, by H. W. Beecher and R. D. Watt. (*Transactions of the A.S.M.E.*, April, 1941, Vol. 63, No. 3, p. 177).

Compilation of essential facts made apparent by many years of experience in dealing with this rather abstruse subject. The waste products resulting from the manufacture of lumber, plywood, or cellulose for conversion into pulp are available as fuel. Hog fuel. Economic aspects. Hog fuel is the principal fuel used in the Pacific Northwest for steam production. With 60 per cent efficiency the available heat per average unit would be 12,000,000 Btu. Measurement of hog fuel. Availability of waste-wood fuel. Transportation of hog fuel. Heating value. Combustion. Design of furnaces to burn hog fuel. Driers. Cinder nuisance. Boiler capacities.

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MACHINING, MACHINE TOOLS.

Sensitive Drill Press Operations, III-IV. (*The Machinist, April 5, 1941, Vol. 85, No. 2, p. 27*). V-VI. (*The Machinist, April 12, 1941, Vol. 85, No. 3, p. 91*).

III. Methods of holding parts. Allowed values and tables. Cleaning and oiling. Formulas. Table No. 2, regarding conditions to drill brass.

IV. Material being machined. Drilling speed. Tapping speed. Table No. 3, regarding conditions to drill cast iron, malleable iron, copper or bronze.

V. Table No. 4, regarding conditions to drill cold rolled steel or hot rolled steel. Table No. 5, regarding conditions to drill cast steel or axle steel.

VI. Procedure. Table of detail operations. Table No. 6, regarding conditions to tap brass, cast iron, copper or annealed steel.

The Wadkin Spar Milling Machine. (*Industrial Power and Fuel Economist, March, 1941, p. 37, 2 figs.*).

The machine comprises a fixed table, mounted on a deep bed which forms a slide for the travelling cutter headstock. It has been specially designed for milling non-ferrous metal aircraft spars up to 25 ft. length at high cutting and feed speeds. The traverse speed has a stepless variation from 7 to 36 ins. per minute. Spindle drive is by a four speed 10 B.H.P. constant horse-power electric motor mounted directly on the spindle housing. Details of spindle bearings. Safeguards. Tapering both sides of a pair of wing spars using two cutters, at 18 in. feed per minute, and tapering the faces of the same, using one 8 in. cutter with $\frac{1}{4}$ in. cut, and a feed of 26 in. per minute.

Cooke Optical Dividing Head. (*Machinery, April 10, 1941, Vol. 58, No. 1487, p. 47, 2 figs.*).

The chief feature of the instrument is that the graduated circle is mounted co-axially with the spindle, as will be seen on reference to the sectional views, and its movement is observed through a micrometer microscope, thus eliminating errors which sometimes occur in mechanical heads, due to inaccuracies in the index plate, and in the worm and worm wheel. The worm gear has no function of measurement, and is used solely for rotating the spindle. Sectional views of the optical dividing head.

CHIPLESS MACHINING, MACHINE TOOLS.

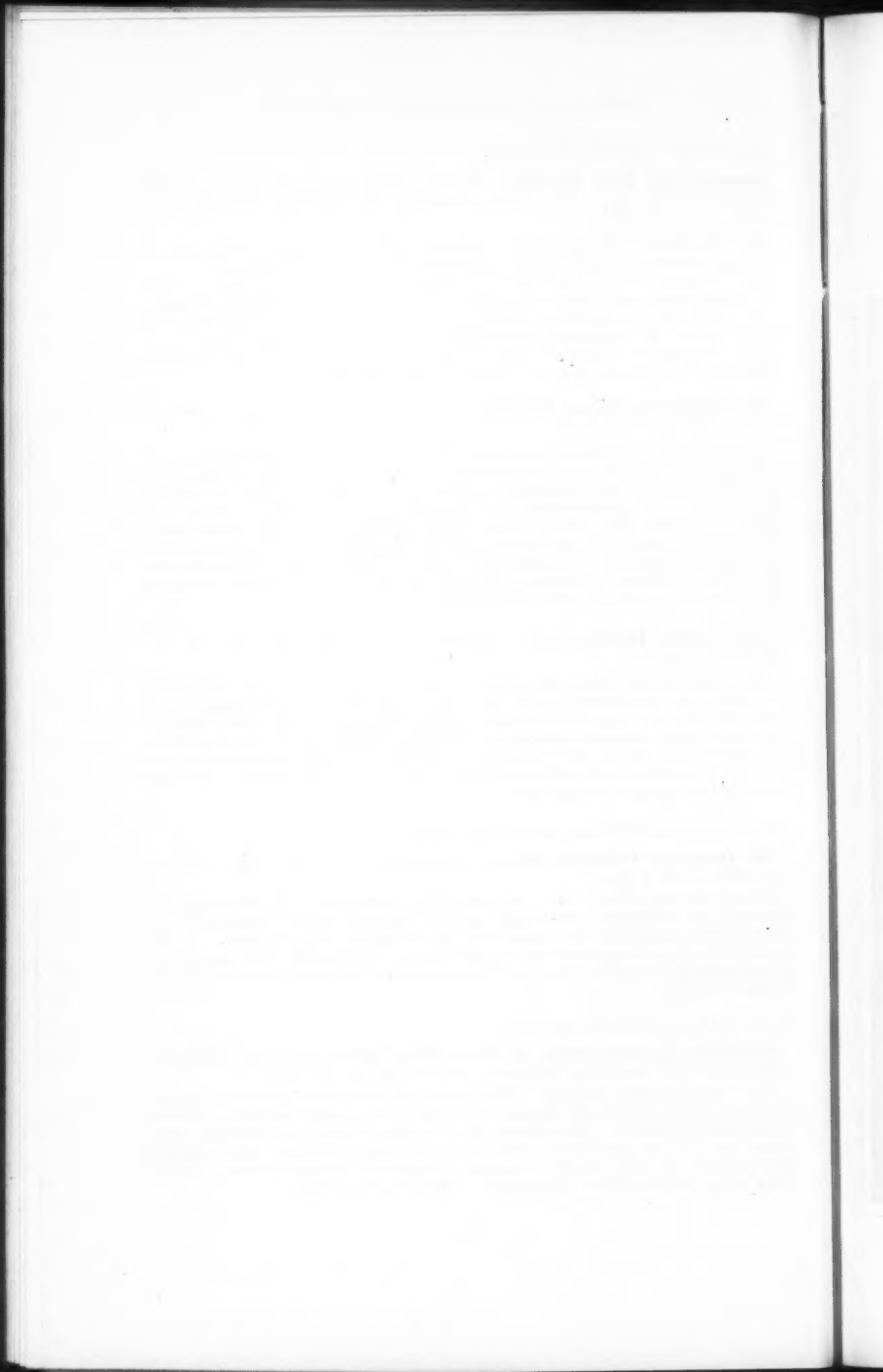
Die Design for Inclinable Presses. (*Machinery, April 24, 1941, Vol. 58, No. 1489, p. 94, 5 figs.*).

Design of separating die. Stripper-plate suspension. A separating die intended for secondary operations on semi-finished stock. Diagrams: (1) Showing the suspension of a knock-out pin-actuated stripper plate. (2) the suspension of a spring-operated stripper plate; (3) another arrangement of spring-operated stripper plate; (4) diagrammatic views of a bending die for simple V-bends.

MANUFACTURING METHODS.

Production of Large Drums for Water Tube Boilers, by P. W. McGuire. (*Industrial Power and Fuel Economist, March, 1941, p. 34, 7 figs.*).

The "Chesterfield" process. First place a hot solid steel billet in a circular bush and punch it vertically in such a way as to leave a solid end on the bottom of the resulting bloom. This bloom, after withdrawal from the punching press, is put on a bar on a horizontal draw bench and pushed through dies to reduce the thickness by the required amount. Adaptable to many steels. Use of back stop. Study of flow of material. Macro-examination.



PRODUCTION ENGINEERING ABSTRACTS

The Hawker Hurricane, by Wilfred E. Goff. (*Aircraft Production*, April, 1941, Vol. III, No. 30, p. 126, 25 figs.).

Production of stressed-skin metal rings. The modifications which have been made since the Hurricane went into service, and describing in detail the manufacture of the metal stressed-skin wings which are fitted as standard to all machines in current production. These units have a particular interest as they represent a departure from traditional Hawker constructional methods.

The Production of Valve Forgings. (*Machinery*, April 10, 1941, Vol. 58, No. 1487, p. 29, 8 figs.).

Electrical upsetting and extrusion methods employed at the works of Guest, Keen & Nettlefolds, Ltd. One of the machines for the electrical upsetting process. Stages in the production of an electrically upset valve forging. One of the presses which form the heads of electrically upset valves. Etched sections showing the grain flow in the upset and the finished forging. The extrusion process. Dies for the production of valves by the extrusion process. Stages in the production of an extruded valve. Finishing operations. Etched sections showing the grain flow in a rough and a finished valve forging produced by extrusion. Tools employed for roughing and finishing valves by the extrusion process.

Photo Lofting in the U.S.A. (*Inter Avia*, No. 747, January 30, 1941, pp. 9-10)

For the manufacture and assembly of individual construction elements of mainly irregular curvatures, such as ribs, transverse frames and bulkheads, which in the finished aircraft determine the curved surfaces, the aircraft industry has for a long time employed a method it borrowed from the ship-building industry. For these parts full-size drawings were made and traced on metal sheets by hand which afterwards were cut out and used as templates. In order to simplify this complicated and lengthy operation which caused a great loss of time between the design and the quantity production of the aeroplane, an engineer of the Lockheed Aircraft Corporation, has developed a method which has already been adopted by several aircraft firms. The engineering drawings are photographed on 14 by 17 in. plates and subsequently projected to the full size of the aircraft parts on sensitised template metal sheets by means of a projector camera. Immediately afterwards the drawing is again projected in full size on a sensitised tracing cloth which is used for the preparation of the blueprints; in the meantime the template is cut out and can immediately be employed in the shop. In addition to a great saving of time, the photo-loft process has the advantage of eliminating a whole series of possible sources of error.

(Communicated by D.S.R.—Ministry of Aircraft Production.)

MATERIALS.

Progress of Magnesium Production in the British Empire by C. J. P. Ball. (*Met. Ind.* (Lond.), February 14, 1941, Vol. 58, No. 7, p. 162).

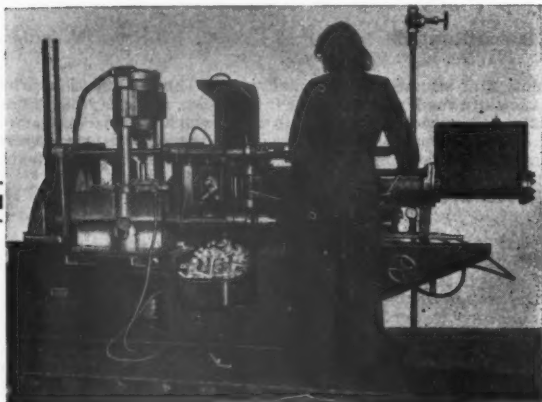
Traces the development of Mg production in this country and in the Dominions and briefly outlines properties and applications.

(Communicated by British Non-Ferrous Metals Research Association.)

MATERIAL TESTING.

Flakes and Cooling Cracks in Forgings, by Francis B. Foley. (*The Wild-Barfield Heat-Treatment Journal*, March 1941, Vol. IV, No. 28, p. 36, 4 figs.).

The most insidious defect which developed in the manufacture of ordnance during "World War I" was the one to which the name "Flake" was given



No. 12 DIE CASTER for zinc base alloys.
Capacity $12\frac{1}{2}'' \times 12\frac{1}{2}''$

DIE CASTING 'DILUTION'

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The pneumatic system of the die carriage does all the hard work ; the actual manual control is extremely light and sensitive.

Here then is the solution to one dilution problem. E.M.B. Die Casting Service includes advice on die design, cropping, piercing and broaching equipment for trimming and finishing.

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PRODUCTION ENGINEERING ABSTRACTS

Lack of experience in melting and forging large sections of alloy steel was no doubt responsible for most of the trouble. The basic electric furnace produced the greatest amount of "flaky" steel. Acid steel is less prone than basic to develop defects of this type. Two types of flakes. (1) the "snowflake," (2) the cooling crack. Eliminating flakes by heat-treatment. Effects of overheating in forging. Slow cooling a cure. Effect of hydrogen. Grain size and its effect.

Fatigue and Damping Studies of Aircraft Sheet Materials, by R. M. Brick and Arthur Phillips. (*Sheet Metal Industries*, April, 1941, Vol. 15, No. 168, p. 511, 8 figs.).

The strong wrought aluminium alloys, 24ST and Alclad 24ST, and nine 18-8 type commercial grades of stainless steels of low and moderate carbon contents, and in the annealed, cold-rolled, stabilized and aged conditions were fatigued under constant deflection conditions. The effects of the two opposing factors, work hardening and cracking, were studied by means of damping and mechanical hysteresis (load-bending) tests on actual fatigue specimens at various intervals during stressing above and near the endurance limit. Very considerable changes took place in Alclad specimens, but changes in the stainless steels were relatively slight, although considerable differences were found among the various types studied.

Polishing Cast-Iron Micro-specimens, and the Metallography of Graphite Flakes, by H. Morrogh. (*Engineering*, April 11, 1941, Vol. 151, No. 3926, p. 297).

It is the purpose of this paper to point out that perfectly polished micro-specimens of grey or malleable cast iron can be obtained with the graphite intact; to give a description of the process used, and to indicate what parts of a general technique should be avoided if perfectly prepared specimens are to be obtained. Successful use of emery papers. Alternate polishing and etching. The technique of the process worked out by the author. Internal structure of graphite in cast-iron micro-specimens prepared by the improved technique. Non-metallic inclusions. Temper carbon.

MEASURING METHODS, APPARATUS.

An Eddy-Current Method of Flaw Detection in Nonmagnetic Metals, by Ross Gunn. (*Journal of Applied Mechanics*, March, 1941, Vol. 8, No. 1, p. A-22, 10 figs.).

An equipment suitable for the location of surface or submerged flaws in nonmagnetic metals is described. A predetermined pattern of electrical eddy currents is induced in a perfect test sample by alternating magnetic fields. Sensitive pickup coils properly disposed in relation to the eddy currents measure only the departures of the eddy-current pattern from the pattern in the perfect sample. The departures are indicated on a meter or may be recorded. Performance data are given for a universal type of search unit especially adapted for general surveys.

MECHANICS, MATHEMATICS.

Vibration Problems, by A. L. Kimball. (*Journal of Applied Mechanics*, March, 1941, Vol. 8, No. 1, p. A-37, 2 figs.).

Classification of vibration phenomena. Energy dissipation is cyclical. Logarithmic decrement. Formulas for logarithmic decrement. Decaying vibrations with damping. Sustained vibrations with damping. Vibration decrement magnitudes. Solid friction.



Getting down to size

THIS illustration tersely expresses what is expected in many cutting operations to-day. The tool has to get the metal down to size with speed and accuracy. How well it can be assisted by the cutting oil is demonstrated by the photograph above.

Look at the formation of those turnings—that's real machining. And note the piston circumference, that's COOLEDDGE finish. Are you getting comparable service from your cutting oil? A trial sample will be gladly sent you free of charge.

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PHOTOGRAPH: First operation in rough turning and facing piston of hiduminium R.R. 59 aluminium alloy The Herbert No. 4 lathe is cutting at 500 r.p.m. and feeding COOLEDDGE water soluble cutting oil as a one in 20 emulsion. [Courtesy the DE HAVILLAND AIRCRAFT CO. LTD., Edgware].

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AT OUR EXPENSE. Test COOLEDDGE at our expense by sending for a trial sample, adequate for shop test. This will come to you free of charge provided application is made on your business heading.

POWER, DRIVE.

Transient Torques in Induction-Motor Drives, by A. M. Wahl. (*Journal of Applied Mechanics*, March, 1941, Vol. 8, No. 1, p. A-17, 9 figs.).

When an induction motor is thrown across the line by the sudden closing of a switch, transient pulsating torques, which in typical cases may reach values from 3 to 6 times the normal starting torques, are set up in the shafts, gearing, and couplings of the connected system. The actual magnitude of these torques depends not only upon the electrical characteristics of the motor but also on the mechanical characteristics of the drive, i.e., coupling flexibility motor, and load inertias. A method is developed for calculating such systems, a typical example being the roll-table drive used in continuous strip mills. tests on typical drives, carried out in parallel with the theoretical work, indicate that the method of calculation is satisfactory for practical use.

PSYCHOLOGICAL INVESTIGATION.

Personality Tests in the Personnel Program, by Guy W. Wadsworth, Jr. (*American Management Association, Personnel Series, No. 50, p. 4*).

Nature of personality. Environmental adjustment. Development of personality diagnosis. Kent-Rosanoff test. Importance of collateral information. Completing the diagnosis. The symptomatic pattern. Society's "code of discounts." How good are current tests? Miracles preferred. Need for expert understanding. Survey findings. Improvement in hiring.

Problems in Selecting and Training Supervisors, by Dr. R. B. Hersey. (*American Management Association, Personnel Series, No. 47, p. 20*).

Supervisors cannot be developed overnight. How the problem was attacked. Measurement of mental abilities and characteristics. Preparation of rating scale. Application of program. Prognostic interviews. Five factors considered in promotions. 1. Mental abilities and characteristics. 2. Physical characteristics. 3. Personality traits. 4. Training and experience, including seniority. 5. "X" factors. Results of program.

Psychological Tests for Unskilled Jobs, by D. W. Cook. (*American Management Association, Personnel Series, No. 50, p. 18, 8 figs.*).

The selection procedure. Purpose of psychological testing. Job analysis: the basis of test development. Individual differences: the basis of industrial testing. Some results of test standardization at the Kearny works. (1) Coil winders' test. (2) Solderers. (3) Relay adjusters. (4) Cable formers. (5) Testers and inspectors. (6) Junior draftsmen. Use to be made of already standardised tests.

New Selection Methods for Defense Jobs, by C. L. Shartle. (*American Management Association, Personnel Series, No. 50, p. 30, 2 figs.*).

Analysis of 60,000 jobs. Job analysis training. Trade tests. Employment interview improved. Employment tests for aptitude. Checking by paired comparison ratings. Techniques for transfer of skill. Other functions.

SHOP MANAGEMENT.

Interchanging Idea Between Management and Employees, by J. J. Evans, Jr. (*American Management Association, Personnel Series, No. 46, p. 9*).

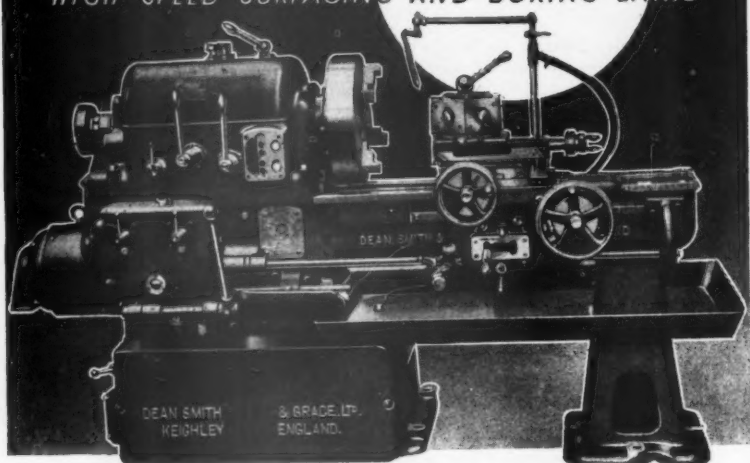
Changes in modus operandi. Employees' share in benefits greater. Evolution in management attitude unrecognized. Case history of an employee relations program. Analysis of organisation. Employee survey and findings.

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Designed to fill a long-felt want—capable of performing most of the functions of a turret lathe but without complications and at a lower figure.

Dean **SMITH** & Grace Ltd
Keighley England

PRODUCTION ENGINEERING ABSTRACTS

Management's objectives. Methods of transmitting information. Supervisory training patterned after sales training. Plant conferences. Attitude survey conducted by supervisors. Production management course. Union-management co-operation. Enthusiasm for "open house" program. Orientation of new employees. Manual of personnel principles. Other informative channels. Minor features.

Putting Job Rating to Work, by A. L. Kress (*American Management Association, Personnel Series, No. 49, p. 3*).

Introduction. I. Job classification structure. Two separate courses may be followed. 1. Set up an occupational wage for each job. 2. Set up a series of "labour grades" and establish occupational wages for these grades rather than for jobs. II. Translating ratings into rates. (a) Establishing minima and maxima. (b) Setting up the rate ranges. 1. How much overlapping shall there be in rate ranges? 2. Should the rate range be set up in terms of flat cents per grade, such as \$.06, or would the increment increase as we get up into the higher grades? III. Incentive wages. This involves two basic considerations: 1. What per cent incentive shall be used, over the daywork rates? 2. What shall be the policy as to guaranteed rates? IV. Hiring rates. Three points should be considered involving the fixing of: 1. A minimum for inexperience persons below which no one will be hired. 2. A minimum hiring rate by grades for experienced persons. 3. A progression scale or learning curve for every job. V. Administering the plan. Fundamentals: 1. Every employee must be assigned to a specific job. 2. If an employee performs more than one job the company must decide whether: (a) the man shall be classified according to the highest skilled job he is called on to do a substantial part of the time? (b) A combination job shall be set up? (c) The man shall take the rate of the individual job to which he may be assigned, from time to time? 3. A "perpetual inventory" of manpower, so to speak, should be maintained on an occupational job basis, showing every specific job: (a) the job classification, (b) the approved rate range, (c) details as to the men so classified, their starting data, man rating if any, present rate, date and amount of previous increases, (d) incentive average hourly earnings, if any.

I. Job classification structure by Carroll E. French.

II. Translating ratings into rates by Samuel L. H. Burk.

III. Incentive wages by Eugene J. Bengé.

IV. Hiring rates by Mr. French.

V. Administering the plan by Albert S. Redway.

SMALL TOOLS.

Carbide Tools Brazed at Low Cost, by W. S. Morse. (*Iron Age, January 23, 1941, Vol. 147, No. 4, p. 32*).

Brief description of furnace brazing of carbide tips to steel tools. The atmosphere used is approximately 2/1 nitrogen/carbide monoxide, the cycle consisting of 15 mins. pre-heat, 5 mins. brazing and 70 mins. cooling.

(Communicated by British Non-Ferrous Metals Research Association.)

SURFACE TREATMENT.

Metal Finishing: Recent Developments, by A. Bregman. (*Iron Age, January 9, 1941, Vol. 147, p. 29, January 16, 1941, Vol. 147 (3), p. 36, January 23, 1941, Vol. 147 No. 4, p. 41*).

A survey of recent literature on electrodeposition (general aspects); electrolytic polishing; cleaning; handling plating solutions; electrodeposition of Ni, Cu, Zn, Ag, and other metals, brass, Co-Ni, Cu-Ni-Zn, and other alloys;

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PRODUCTION ENGINEERING ABSTRACTS

metal colouring; corrosion-resistant finishes; specifications and testing; electroplating on Al and stainless steel; organic finishes; equipment and supplies. Bibliography of 80 references.

Communicated by British Non-Ferrous Metals Research Association.

Surface Treatment of Magnesium Alloy, Schmidt and others. (*Foundry Trade Journal*, March 13, 1941, pp. 175-7).

This paper discusses the various methods of protecting magnesium alloys against corrosion by the atmosphere salt water or other corrosive environment. It is stated that numerous tests and industrial uses of magnesium have proved that this metal is remarkably resistant to arduous atmospheric corrosion conditions. Details of some nine different processes for protective chemical coatings are given.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

TECHNICAL EDUCATION.

Basic Principles of Learning and Their Application in Training, by Carl Iver Hovland. (*American Management Association, Personnel Series, No. 47, p. 3*).

Training objectives. Content of program—developing sound training idea. Selection of training media. Observance of learning principles. 1. Stress correct procedure from the start. 2. Train on actual operations. 3. Space training trials. 4. Train in natural units, not piece-meal. Accuracy or speed? How much guidance? Motivation.

Mass Instruction of Inexperienced Employees, by C. S. Mattoon. (*American Management Association, Personnel Series, No. 47, p. 32*).

The manpower problem. Three distinct plans. 1. Observer method for learners. 2. Retraining semi-skilled men in special techniques. 3. Training beginners in repetitive operations. Careful selection essential.

Organising for Supervisory and Executive Training, by R. C. Oberdahn. (*American Management Association, Personnel Series, No. 47, p. 15*).

Leadership training program. Foreman training program. General Foremen. Superintendents.

WELDING, BRAZING, SOLDERING.

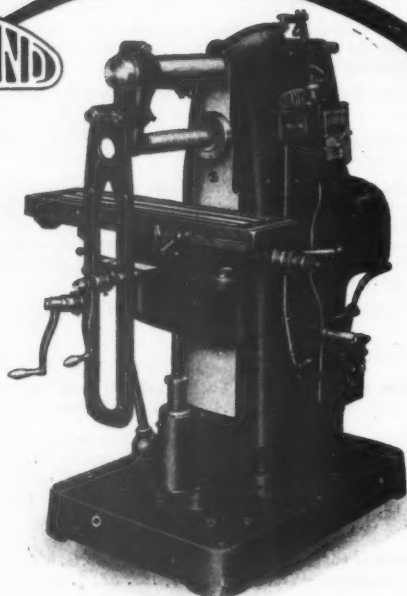
Welding of Airframes, by W. Corns. (*Aircraft Production*, April, 1941, Vol. III, No. 30, p. 136, 14 figs.).

Part III. Directional welding: Queen Wasp and Oxford units: Advice to the draughtsman. Principles of directional welding and their application by a number of examples taken from various types of aircraft.

The Problem of Training Welders, by D. M. Kerr. (*The Welding Industry*, April, 1941, Vol. IX, No. 3, p. 67, 1 fig.).

Effect of war conditions. Methodical selection of men. Division of instruction. Proficiency standard. Basic training. War-time welders. Single operation training. Allocation of trainees. Determination of potentialities.

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PRODUCTION ENGINEERING ABSTRACTS

Tinning and Soldering Copper, by R. T. Seckerson. (*Sheet Metal Industries*, April, 1941, Vol. 15, No. 168, p. 523, 3 figs.).

The mechanism of tinning. Properties of the soldering flux. Flux corrosion. Hand soldering. Choice of solder. Hot dipping of copper. The dipping operation.

Soft Solders and Fluxes, by C. W. Hart. (*Machinery*, April 17, 1941, Vol. 58, No. 1488, p. 63).

Physical properties of tinman's solders. B.S.S. Grade. Temperature at which melting commences. Temperature at which alloy is completely molten. Tensile strength. Tons per sq. inch. Elongation. Per cent. Solders for dipping work. Soft solders for high-temperature service. Lead-free solders. Solders for aluminium. Fusible solders. Soldering fluxes. (a) Protective or safety fluxes. (b) Active fluxes comprise the ordinary types used for sheet-metal and general soldering work. Tinning compounds and creams.

Soldering Aluminium and Its Alloys, by Anon. (*Light Metals*, March, 1941, Vol. 4, No. 38, p. 64).

A brief summary of solders (including reaction solders), soldering technique and applications of soldered joints.

Communicated by British Non-Ferrous Metals Research Association.

WELFARE, SAFETY, ACCIDENTS.

Physique and Health for the Job, by Ronald E. Lane. (*Industrial Welfare and Personnel Management*, April, 1941, p. 73).

The object of those engaged in industry at the present time must be to increase and maintain output. Difficulties arising directly from the war are shortage of labour, insufficient transport, air raids and black-out. Fitting the job to the worker. Hours of work. Night work. Weight lifting and carrying. Women in industry. Feeding. Infections. Much can be done to prevent some types of infection by (a) ventilation, (b) suppression of dust. (c) Screens and masks.

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Research Department: Production Engineering Abstracts

(Edited by Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

BELTS AND ROPES.

The Effect of Reversing Flat Leather Belts—Hair Side versus Flesh Side. by D. F. Galloway. (*Journal of the Institution of Production Engineers*, May, 1941, Vol. XX, No. 5, p. 139, 2 figs.).

More than 70% of the machines in use are still driven by belts from line shafts, it is essential that these belts should be capable of transmitting the power for which the machine tool was designed. A 10 h.p. lathe with belt speeds between 1,400 ft. per minute and 1,700 ft. per minute was tested in the research department and found to have an output of only 6.5 i.p. The belts were then reversed so that they were driving on the hair side instead of the flesh side, and an increase of approximately 35% of the power (up to 9.1 h.p.) available at the workpiece was observed. Arrangement of equipment for test. Graph of results of tests. Relation between apparent total slip and brake horse power for used belts.

The Arc of Contact, by H. Stuart Jude. (*Power Transmission*, April, 1941, Vol. 10, No. 111, p. 117, 4 figs.).

The theory of the arc of contact in belting and its effect in practice. It is the smaller of the two pulleys which counts, irrespective of whether it is the driver or the driven. Arc on open belt. Arc on crossed belt. Effect on transmission. The area of contact. Planning a drive.

COMBUSTION, FURNACE.

A New Electrode Type Salt Bath, by H. J. Tucker. (*Machines*, May 22, 1941, Vol. 58, No. 1493, p. 207, 9 figs.).

The bath operates on the principle of heating from the inside out, a method which has proved in practice to be extremely economical in fuel costs, with the additional advantages of greatly increased pot life and low maintenance charges. Layout showing a bath with only one pair of electrodes. Layout showing a multi-electrode arrangement for a large batch type bath. Bath for heat treating gudgeon pins, etc. Equipment for local hardening of pinion gears. Battery of Efco-Ajax-Hultgren furnaces for the heat treatment of high-speed steels. Heat treatment of high speed steel. Continuous unit for the local hardening of valve piston rods. Heating for forging. Ferrous and non-ferrous strip, sheet and wire annealing. Cross section through the continuous unit for valve piston rod. Dip brazing automobile oil filter assemblies.

Protective Atmospheres for Hardening Steel, by J. R. Grier. [*Ind. and Eng. Chem. (Ind. ed.)*, Vol. 33, No. 1, January, 1941, p. 38].

This paper attempts to explain the fundamental chemical requirements of protective atmospheres for steels and to discuss briefly characteristics of the

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PRODUCTION ENGINEERING ABSTRACTS

typical atmospheres now in commercial use. An improved atmosphere is described which appears to meet a definite need in the heat treating of steels. It is shown that, by passing mixtures of air and hydrocarbon gas in controlled proportions over an electrically heated catalyst, the carbon pressure of the product (endogas) can be regulated to any desired value. The procedure is used to produce a protective atmosphere than can be adjusted to equilibrium with steels of any carbon content.

(Communicated by the D.S.R., Ministry of Aircraft Production).

EMPLOYEES, WORKMEN, APPRENTICES.

The Functions of the Design Engineer, by W. E. Johnson. (*Mechanical Engineering*, May, 1941, Vol. 63, No. 5, p. 339).

The chief attributes or functions required of the designer are the acquisition of useful knowledge, the ability to think creatively, the ability to visualise, an aptitude for prognosis, analytical ability, diagnostic ability, the ability to communicate clearly, administrative ability, sound personal character.

Dilution—Its Effects on Labour and Production, by J. H. Mills. (*Industrial Power and Fuel Economist*, April, 1941, Vol. XVII, No. 187, p. 50).

Accurate tooling. Dilution in inspection. Jealousy of the skilled man. Mainspring of discontent. Overhauling apprenticeship. The welfare department.

FOUNDRY, MOULDING.

Die Casting of Aircraft Parts. (*Aircraft Production*, May, 1941, Vol. III, No. 31, p. 179, 5 figs.).

American foundry technique, tool design, and examples of production costs. Tool and production figures are quoted, pictures of typical examples of work done are shown, whilst views of sections of one of the largest aircraft die casting firms indicate the type of equipment in general use. Views in the large Harvill die-casting plant recently erected at Los Angeles.

Medium Batch Die Casting, by H. A. Stock. (*Journal of the Institution of Production Engineers*, March, 1941, Vol. XX, No. 3, p. 63, 9 figs.).

Die casting from the design and production viewpoints. The general sequence of operations is described. Shrinkage allowance, venting, elimination of porosity, and the use of inserts are among the factors considered. The discussion includes references to the maximum casting weight and number of shots per hour, the materials used for die cores and castings, the effect of shrinkage stresses between casting and die, the dimensional accuracy of castings, ejection of castings from the die, and the problem of small quantity die casting.

GEARING.

Gear Tooth Loading—II, by A. B. White. (*Power Transmission*, April, 1941, Vol. 10, No. 111, p. 110, 1 fig.).

The Lewis formula, static and dynamic stresses,
$$\frac{600 \times \text{static stress}}{600 + \text{pitch line velocity}}$$

Bevel gears. For all practical purposes, the Lewis formula can be amended to the following for bevel: teeth $W = \frac{1}{3}$ s.p.f.y. Helical gears. Empirical

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PRODUCTION ENGINEERING ABSTRACTS

formulae are (1) $K = \frac{P}{D}$ (2) $K = \frac{P}{\sqrt{D}}$. Extensions to Lewis formula. The

latest expression is: $W = \frac{I}{K} s p f (0.278 - \frac{2.69}{N}) V_a$ where W = load, s =

ultimate stress of material, p = circular pitch, f = face width, N = number of teeth, V = velocity coefficient, K = factor safety. The value of the safety factor was varied for different types of load as follows : four for steady loads, six for sudden loads, eight for sudden loads with reversals.

JIGS AND FIXTURES.

Supply of Jigs, Tools, and Gauges for War Production. (*Industrial Power and Fuel Economist*, April, 1941, Vol. XVII, No. 187, p. 59).

Eight suggestions by the Institution of Production Engineers for increasing the country's manufacturing facilities. The present position. Effect on production planning. Effect on labour situation. Effect on the utilisation of machine tools. Cumulative effect on production. Remedial action.

Tool Engineering, by Frank W. Curtis. (*The Tool Engineer*, March, 1941, Vol. X, No. 3, p. 39, 17 figs.).

Factors influencing the design of jigs and fixtures, an outline of units used in fixture construction, and representative examples of tool installations. There are three ways to design jigs and fixtures : (1) Built-up type made from small parts, (2) cast design made from patterns, (3) welded or fabricated construction. Built-up tooling is often used where a quick or temporary jig or fixture is wanted, and is usually limited to small parts. Cast fixture bodies require a pattern for the casting, which in turn is comparatively easy to machine. Welded tooling, however, is being favoured in many instances because the body can often be completed as quickly as a pattern for the cast type thus saving time and expense. Several forms of welded joints. The usual procedure in building welded tools is to (1) cut out all parts, (2) tack weld parts together, (3) check assembly for correct proportions, (4) electric weld all seams and joints, (5) normalise, (6) machine. Correct principles of fixture design. Several types of fixture clamps. Varieties of cam type fixture clamps. Varieties of fixture jacks. Varieties of vise jaws. Design of tungsten carbide cutting tools. Application of law of deflection. Fixture for milling cam face. Machining aeroplane cylinder head. Unusual fixture for tapping radial engine crankcase.

MACHINE ELEMENTS.

Ring-oiled Journal Bearings, by D. A. Field. (*Mechanical World*, May 9, 1941, Vol. CIX, No. 2836, p. 318, 5 figs.).

The problem is to determine whether a bearing will run at a certain speed without recourse to oil or water cooling. Diagram on temperatures in journal bearings. Coefficient of friction for 90° central clearance bearings. Clearance ratio in top half for 90° central clearance bearings. Minimum oil film thickness for 90° central clearance bearings. Limiting speeds for self-cooled ring-oiled journal bearings, 90° arc-clearance type.

Lining White Metal Bearings, by H. Warburton. (*Mechanical World*, May 16, 1941, Vol. CIX, No. 2837, p. 333, 9 figs.).

In many instances, steel backed white metal lined shells have entirely superseded bronze bearings. In the case of cast iron shells, mechanical anchor-

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PRODUCTION ENGINEERING ABSTRACTS

age is used to ensure the lining is firmly anchored to the shell. The use of mechanical anchorage to other metals, such as steel or bronze is not to be recommended. When the metallizing is done properly it is possible to obtain a bond between the two which is stronger than the bearing metal itself. Fluxing, tinning, and correct pouring temperature will ensure strong adhesion and will substantially improve the performance and reliability of this class of bearing. It is essential that the bearing shell and mandrel be heated before the pouring takes place, and they must be kept hot by means of the blowpipe until the metal is ready. Temperature control during pouring is a factor which can play an important part in the active life of the bearing. Useful form of lining jig which is adaptable to a wide range of bearings. Machining jig for turning on collars and end faces. Mandrel for machining collars and belts (two halves are machined at once). Jig for immersing shell in molten metal. A good white metal is made up by melting together 4 lb. of copper, 8 lb. of antimony, and 24 lb. of tin (the hardening mixture).

MACHINING.

The Influence of Warming Up, by G. Schlesinger. (*The Journal of the Institution of Production Engineers*, April, 1941, Vol. XX, No. 4, p. 103, 15 figs.).

The working accuracy of turret lathes both of the horizontal and vertical types depends on the alignment of the axis of the work spindle with the tool holes in the turret head. Every user of turret lathes knows that he must be careful in the morning before the machine has warmed up, to avoid getting scrap pieces. Table comprising production times for various batches of 1-5-10-100 pieces on centre lathes versus capstan lathes. Capstan lathe loaded with Prony brake for test purposes. Horizontal expansion after half, one, two hours running-in considering standstills and change of speeds. Effect of horizontal movement on diameter of work. Vertical influence of warming up. Stationary dial-gauge on top of spigot. The same conditions as for horizontal expansion. Effect of vertical spindle rise on fixed reamer. Effect of vertical spindle rise on external tools. Measurements taken from alignment tests regarding the cold and warm machine.

Fire Hazards when Machining Magnesium and its Alloys, by L. Whitburn. (*Light Metals*, April, 1941, No. 4, p. 75).

An outline of practice for preventing and extinguishing fires.

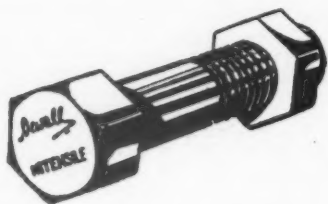
How to Plate Brass and Bronze, by C. B. F. Young. [*Iron Age*, February 13, 1941, No. 147 (7), p. 60 and 104].

Practical details of operations of plating brass (usually about 80/20) bright brass (du Pont de Nemours method) and so-called bronze (about 90/10 cu.-zn.). The effects of additions of ammonia and salts and of variables such as pH, composition of bath, etc., are considered. Plating of cu.-cd. is also briefly outlined.

MACHINE TOOLS.

Drilling Square, Hexagon, and other Holes, by H. C. Town. (*Machinery*, May, 8, 1941, Vol. 58, No. 1491, p. 145, 12 figs.).

Methods of production and setting out of simple tools with work-holding attachments are described herewith. Tool for producing 3 in. square holes. Arrangement of drill and floating holder. Holder with guide cam for square hole drilling tool. Design of jig for supporting chuck screws for square hole drilling. Arrangement for drilling square holes on a lathe. Example of a tool for producing hexagonal holes. Method of generating a hexagonal hole on a gear shaping machine.



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Building the Newall Jig Borer. (*Machinery*, May 15, 1941, Vol. 58, No. 1492, p. 169, 17 figs.).

Methods employed at the works of the Newall Engineering Co. Ltd. The jig borer has assumed a position of paramount importance in the factory. However accurate the gauging equipment in a factory may be, it is of little avail if means do not exist for machining to close limits when making the jigs and fixtures required in the various machine shops. Chart showing the acceptance tests carried out on jig borers. The acceptance tests include an actual boring test on a plate which is afterwards carefully inspected.

Cutting with Abrasives, by R. R. Wiese. (*The Machinist*, May 17, 1941, Vol. 85, No. 8, p. 97, 2 figs.).

Better bends for abrasive wheels have extended their use on a wide range of cut-off operations. General recommendations for cutting wheels. Typical dry cutting performances. Resinoid and rubber bonds. Hard wheels for high output. Speed helps wheel life.

Design and Construction of Machine Tool Parts in Fabricated Steel, by F. Koenigsberger. (*Machinery*, May 8, 1941, Vol. 58, No. 1491, p. 149, 14 figs.).

The main points at issue are (1) strength of the structure, (2) rigidity against deformation, (3) rigidity against vibration, (4) economy of design and construction. Simple structures such as beds and uprights, if designed in the right way, can be economically produced even in large quantities by welded construction. Production milling machine of fabricated steel construction. The welding of the body. A view of the body structure of the fabricated milling machine. A sectional view of the body showing the plates for the reception of the cast iron slideways. A cross-section through the upright. A cross section through the outer stay. The details required for the welded body assembly. A cross section through the overarm. A longitudinal section through the headstock. A transverse section through the headstock. A plan view of the saddle. The comparison of costs of a fabricated construction versus cast iron shows that, apart from the technical advantages, the cost of the fabricated construction is lower than that of the cast-iron construction.

CHIPLESS MACHINING.

Research has Provided a Smooth Drive for a Tinning Unit, by W. E. Hoare. (*Sheet Metal Industries*, May, 1941, Vol. 15, No. 169, p. 623, 3 figs.).


It is necessary to provide for variation in the distance between the axes of the grease-pot rollers, for the following reasons: (1) To accommodate sheets of different thickness, (2) to compensate for variations in thickness of a single sheet, (3) to take up loss of diameter during the working life of the rollers. Diagram of driving mechanism on experimental machine.

MANUFACTURING METHODS.

The Manufacture of Zinc-alloy Wire, by E. Schmid and R. Wever. (*Machinery*, May 8, 1941, Vol. 58, No. 1491, p. 153, 7 figs.).

Choice of suitable material. Composition of alloys investigated—aluminium, copper, balance, density. Results of experiments in upsetting zinc and zinc alloys. Hot rolling. Effects of annealing 0.4 in. rolled Zn-Al₄ wire at various temperatures. Effects of annealing Zn-Al₄ wire at various temperatures. Mechanical properties of rolled wire. Alloy. Tensile strength in kg./mm². Elastic limit in kg./mm². Elongation per cent. Effects of annealing drawn

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Zn-Al wire at various temperatures. Effects of cold working on the tensile strength and elongation of zinc alloy wires. Properties of finished wire.

The Manufacture of Pneumatic Mining Equipment. (*Machinery*, May 29, 1941, Vol. 58, No. 1494, p. 225, 16 figs.).

Methods employed at the factory of the Climax Rock Drill and Engineering Works, Ltd.

Tooling Set-ups for High Explosive Shells—I, by Ben C. Brosheer. (*The Machinist*, May 10, 1941, Vol. 85, No. 7, p. 59, 30 figs.).

Tooling Set-ups for High Explosive Shells—II. (*The Machinist*, May 24, 1941, Vol. 85, No. 9, p. 111, 31 figs.).

Features of the Liberator. (*Aircraft Production*, May, 1941, Vol. III, No. 31, p. 156, 12 figs.).

Production processes and characteristics of the consolidated B-24 four engined bomber.

Metal Spraying, by Schori Process Corp. [*Iron Age*, February 6, 1941, No. 147 (6), p. 46].

In the Schori method the metal (notably Zn) is used in powdered form instead of wire. The advantages claimed for the method are described, together with procedure and many applications of sprayed Zn coatings. Al, Cu, Sn, bronze, and Cd can also be sprayed by the method.

MATERIALS, MATERIALS TESTING.

New Uses of Elektron Sheet, by D. B. Winter. (*Aircraft Production*, May, 1941, Vol. 3, No. 31, p. 153, 5 figs.).

The introduction of magnesium alloy sheet in the production shop. Difficulties in production shops. Proposed design of a tail fin constructed entirely of elektron. Comparison between structures in magnesium alloy D.T.D.118 and 142 and in L.3 aluminium alloy. Designing for magnesium. The use of heavy gauge sheet. Structural comparisons. Organisation of production department. Proposed layout of an experimental shop for the manufacture of magnesium alloy sheet.

Rubbers—Natural and Synthetic, by J. W. Schade. (*J. Aeron. Sci.*, Vol. 8, No. 5, March, 1941, p. 177).

The meaning of the word rubber has changed since the advent of synthetic materials similar to the natural product. It is now used to designate a class of flexible, elastic materials rather than a particular hydrocarbon product of natural origin. The synthetic rubbers are classified into five types. The mechanical properties of all types are determined not by the kind of chemical elements composing them but rather by the arrangement of these elements, the size of the molecules and by structures produced by vulcanisation. All rubbers are modified by addition of other materials to fit them for a variety of uses. Differences in chemical composition and in the properties of natural and synthetic rubbers are shown in tabular form. Mechanically, natural rubber is not surpassed by any synthetic rubber. However, in resistance to swelling by organic liquids, such as petrol and oils, and to deterioration by sunlight or oxidising agents synthetic rubbers have been found superior. These characteristics directed commercial applications to those fields where these properties are particularly needed.

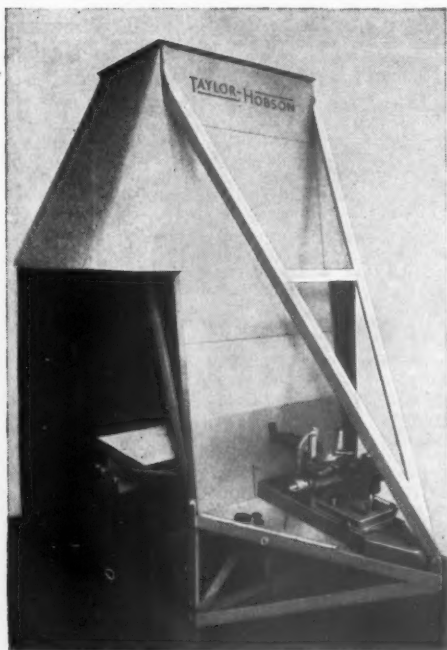
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PRODUCTION ENGINEERING ABSTRACTS

Quenching Stresses in Aluminium Alloys, by Zeerlander. (*J. Inst. Met.*, March, 1941, p. 87).

This paper deals with the internal stresses in Avional D alloy set up by quenching, and of the possibility of eliminating them by subsequent cold work. The method used for determining the stresses consisted in measuring the dimensional changes of the stock during step-by-step removal of the outer layers. The variables studied are time between solution treatment and quenching, temperature and nature of the quenching medium, temperature of ageing, and cold working before or after ageing. It is shown that the stresses are materially reduced and may even be reversed by cold working before or after ageing. Illustrated by one photograph and twelve graphs.

(Abstract supplied by Met. Vick. Research Dept.)

Magnesium in Aircraft. (*Inter Avia.*, No. 759, April 9, 1941, p. 8).

In order to improve the aerodynamic refinement of an aeroplane very smooth surfaces are required, and great demands are placed on the buckling strength of the aircraft skin, for example in dives. By means of flush riveting, spot welding, and other methods, satisfactorily smooth surfaces can be obtained. However, the strength of thin-gauge skins is not sufficient to maintain the surface smoothness also under great loads, as a result of which increasingly heavy skins will be required in monocoque construction. Furthermore, the loads placed on the skin by the local formation of compressibility shock, resulting from the velocity of sound being exceeded locally, can grow to such an extent that heavier sheet than heretofore must be employed. According to the Dow Chemical Co. (spring session of the Society of Automotive Engineers) magnesium alloys are quite suitable for use as skin material in view of their low specific gravity.

Fabric Bearings—I and II, by D. Proctor. (*Mechanical World*, May 23 and 30, 1941, Vol. CIX, No. 2838/39, pp. 347 and 369, 13 figs. and 10 figs.).

I—The material, its construction and properties, application to bearing manufacture, rolling mill bearings, journal bearings, loading, speeds, etc., lubrication, footstep bearings, collar bearings, bushes, graphite impregnation. Particular advantages (1) longer life, (2) lower power consumption, (3) elimination of oil or grease when this is desirable, (4) reduced wear of shaft or roll neck, (5) ease of installation and replacement, (6) sometimes the only practicable solution to the bearing problem. II—Fabric footstep bearings consist of three parts (a) a hardened steel pad attached to the bottom of the shaft, (b) a fabric thrust pad on which (2) runs, (c) a journal type of bearing. Section of complete footstep bearing showing flow of lubricant. Collar-type thrust bearing.

Tube and Section Manipulation with Bismuth Alloys, by A. J. T. Eyles. (*Mechanical World*, May 2, 1941, Vol. CIX, No. 2835, p. 299, 11 figs.).

Cerrobend, an alloy of bismuth, lead, tin, and cadmium, has been specially developed and has peculiar properties, making it an ideal filler for tube bending. An aluminium tube 0.25 in. diameter hand-wound round $\frac{1}{8}$ in. former without rippling or buckling, and a bronze Bourdon tube 0.0035 in. wall thickness bent with complete absence of rippling. Modern aircraft construction, all the tubes were bent with Cerrobend. Stainless steel rolled section bent after being embedded in Cerrobend.



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Plywood for Aircraft. (*Aircraft Production*, May, 1941, Vol. III, No. 31, p. 161, 8 figs.).

Preparation of veneers, jointing and bonding, manufacturing processes employed by Flexo Plywood Industries, Ltd.

Fatigue and Damping Studies of Aircraft Sheet Materials, by R. M. Brick and Arthur Phillips. (*Sheet Metal Industries*, May, 1941, Vol. 15, No. 169, p. 635, 10 figs.).

A complete load-bending cycle for specimens of Duralumin 24 ST, and Alclad 24 ST, showing mechanical hysteresis for the latter. Damping curves of (a) 24 ST three super-imposed sections of an unstressed specimen, (b) Alclad 24 ST two super-imposed sections of an unstressed specimen, (c) same as (b) after fatigue stressing six million cycles at 14,000 lb. per sq. in. (maximum deflection above equivalent to about 28,000 lb. per sq. in.). Damping curves of unstressed stainless steels. Changes in damping of an Alclad 24 ST specimen stressed in fatigue well above its endurance limit. Changes in damping of an Alclad 24 ST specimen stressed in fatigue at close proximity to its endurance limit. Changes in damping of stainless steels on repetition of the damping test.

Atmospheric Exposure Tests on Copper-bearing and other Irons and Steels in the United States, by Ewart S. Taylorson. (*Sheet Metal Industries*, May, 1941, Vol. 15, No. 169, p. 607, 3 figs.).

The results of atmospheric exposure tests of twelve different irons and steels for a period of five years at three locations in the United States of America are reported. These include three steels containing 0.03%, 0.2% and 0.5% of copper respectively, tested by the Corrosion Committee, six steels ranging in copper content from very low to 0.5%, a copper-bearing wrought iron, and two low-alloy steels. The last nine materials were of American origin and were selected to illustrate the large difference in corrosion rate that can be obtained owing to variation in analysis. The locations included an industrial district on marine marshes, an inland industrial district, and a rural district. The results illustrate the great influence of copper and the even greater protective value of higher percentages of alloying elements. The comparative pollution of the atmosphere at these three locations was evaluated by exposure of the Corrosion Committee's standard pollution samples for a period of two years.

Practical Metallography of the Stainless Steels, by S. P. Watkins. (*Metal and Alloys*, February, 1941, Vol. 13, p. 162).

The effects of chromium, nickel, and carbon on the constitution of high chromium and nickel chromium steels. Photomicrographs showing structures typical of steels of varying alloy content. The nature and significance of the four stable phases found in these steels (austenite, sigma, carbides, and ferrite), and the classification of the stainless steels from the metallographic standpoint.

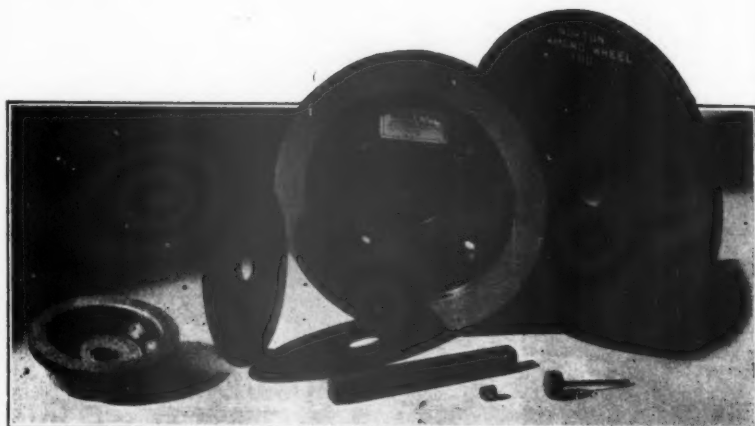
(Abstract supplied by *Nickel Bulletin*, April, 1941, No. 4).

The Testing of Metals, by B. Chalmers. (*Light Metals*, April, 1941, No. 4 Vol. 31, p. 82).

A survey of destructive and non-destructive methods of inspection, emphasising the possibilities inherent in non-destructive indirect testing as a substitute for direct destructive testing. Describes statistical aspects of sampling and discusses mechanical, electrical, magnetic, radiographic, corrosion, abrasion, thermal conductivity, and hardness testing.

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MEASURING METHODS.

Inspection of Repetition Machined Parts for Aircraft. (*Machinery*, May 8, 1941, Vol. 58, No. 1491, p. 141, 9 figs.).

It has been necessary to employ a large amount of semi-skilled labour on inspection, and it has been found essential to develop inspection rigs and other equipment, so as to ensure speed and accuracy and avoid the chance of mistakes occurring. Rotary comparator employed for checking a standard type of socket. Rotary comparator arranged for checking taper bolts. Dial gauge arranged for checking undercuts. Caliper dial gauge for checking all thickness. An inspection stamp made from an automatic centre punch. The use of the inspection methods and special equipment have resulted in a definite increase in the inspection department's output, and the reduction of inspection errors to the lowest possible minimum.

PLASTIC MATERIAL.

Synthetics, by C. P. Kidder. (*Mechanical Engineering*, April, 1941, Vol. 63, No. 4, p. 287, 16 figs.).

Synthetic substances with rubber-like properties. Hose surfaces exposed to direct sunlight for four weeks. Special qualities of neoprene. Conveyor belting used at elevated temperatures, showing comparative heat resistance of rubber and neoprene. Typical applications of neoprene. Effect of immersion in S.A.E. 30 lubricating oil at 82°F. on tensile strength and volume of similar rubber and neoprene compounds. Effect of immersion for twenty-one days in crude oil at 82°F. on tensile strength, tear resistance, and volume of similar rubber and neoprene compounds. Nylon, a recent development of synthetic chemistry. Comparison of elastic recoveries with an imposed load on nylon, silk, acetate rayon, cordura rayon, viscose rayon. Tenacity of several fibres. Water absorption at 60% relative humidity. Cordura rayon for tyres. Salt treatment of wood—a preservative and fire retardant. "Lucite" a transparent plastic. Lucite in the form of cast sheets is proving useful to the aircraft industry for the construction of wind-shields and windows for aeroplanes due to its low density, lack of brittleness, clarity, and stability to light exposure. In the fields of medicine and dentistry instruments made of this plastic in various shapes carry "cold" light from one end of the instrument to the other and permit strong illumination, without heat, of the nose, ear, throat, or other affected parts.

PSYCHOLOGICAL INVESTIGATION.

Electrical Apparatus for Testing Reaction-time and Hand-and-eye Coordination, by R. C. Woods and A. S. MacDonald. (*Journal of the Inst. of Electrical Engineers*, May, 1941, Vol. 88, Part 1, No. 5, p. 189, 6 figs.).

Psychological tests for the selection of staff, of reaction-time, and hand and eye co-ordination tests. Two new instruments, consisting almost wholly of standard telephone components, are described, their operation sequences are given and reference is made to the accuracy of the reaction tester. The results of the practical tests with these instruments are shown and simply discussed.

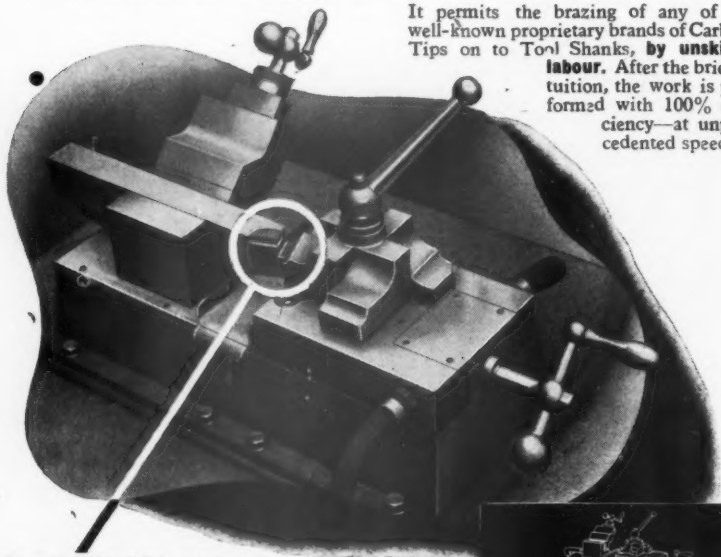
Electrical Apparatus for Testing Reaction-time and Hand-and-eye Coordination, by R. C. Woods and A. S. MacDonald. (*J. Inst. Elec. Eng.*, Vol. 88, Part 1, No. 4, April, 1941, p. 189).

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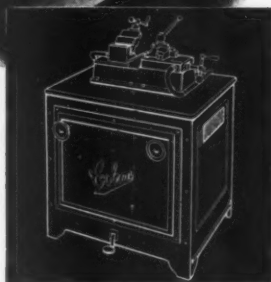
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staff, of reaction-time, and hand-and-eye co-ordination tests. Two new instruments, consisting almost wholly of standard telephone components, are described, their operation sequences are given and reference is made to the accuracy of the reaction tester. The results of the practical tests with these instruments are shown and simply discussed. The instruments, simple to operate and both accurate and reliable, were adequate for their purpose, and it is suggested that they may have a wider application.

(Communicated by D.S.R., Ministry of Aircraft Production).

SMALL TOOLS.

Firth-Brown Zee-lock Serrated-blade Cutters. (*Machinery*, May 22, 1941, Vol. 58, No. 1493, p. 214, 7 figs.).

The Zee-lock facing cutter. High-speed steel and carbide-tipped blades. Views showing the angles on the Zee-lock cutter blades. Speeds in feet per minute for Speedicut high-speed steel blades. Speeds and feeds for carbide Zee-lock cutters. Blade angles for carbide-tipped Zee-lock facing cutter.

Stellite. (*Machinery*, May 29, 1941, Vol. 58, No. 1494, p. 238, 8 figs.).

Recent developments and applications. Red hardness curves for stellite and tool steels. Turning and planing with stellite tools. Wheels recommended for grinding stellite tools. Production data for typical operations using grade 80 stellite. A group of stellite-tipped gauges, including plain and screw plugs, length, and gas types. Hard facing.

SURFACE, SURFACE TREATMENT.

Protective Finishes for Aluminium Aircraft Surfaces. (*Coraly Steel*, March 10, 1941, pp. 66 and 102).

Corrosion may easily reduce the endurance limit of aluminium or aluminium alloy by as much as 67% and hence the retention of maximum physical properties which is so necessary in aircraft construction, necessitates adequate attention to corrosion prevention. * In this article the author details the factors involved and various means of corrosion prevention and describes the practice employed by the Curtiss-Wright Corp. of U.S.A., which involves the production of a tough protective film.

(Abstract supplied by Met. Vick. Research Dept.).

WELDING, BRAZING, SOLDERING.

The Gas Welding of Commercial and Super-purity Aluminium, by E. G. West. (*Transactions of the Institute of Welding*, April, 1941, Vol. IV, No. 2, p. 31, 17 figs.).

Table of the general conditions of testing. Analyses of aluminium. Thickness and condition. Silicon. Iron. Copper. Zinc. Manganese. Aluminium (by difference). The material contained between 99.47 and 99.995 aluminium. Summary of production procedure for aluminium sheets. Experimental procedure. A—welding methods. B—testing procedure (a) visual and radiographic examination, (b) mechanical tests, (c) macro and micro-examination, (d) corrosion tests. Results.

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The Spot Welding of Light Alloys, by R. F. Tylecote. (*Transactions of the Institute of Welding*, April, 1941, Vol. IV, No. 2, p. 56, 19 figs.).

1—Weldability. 2—Machines (i) specifications, (ii) timers. 3—Machine settings (i) current, (ii) time, (iii) pressure, (iv) other variables. 4—Surface preparation (i) chemical preparation, (ii) mechanical preparation, (iii) control of pickling. 5—Electrodes (i) electrode properties, (ii) alloy electrode materials, (iii) electrode design (a) tip shape, (b) cooling, (iv) cleaning. 6—Contact resistance. 7—Strength properties (A) static, (i) single shear, (ii) double shear, (iii) multi-spot joints, (iv) structures, (v) torsion and compression, (vi) bending and tearing. (B) Fatigue. 8—Stress distribution. 9—Heat treatment. 10—Cold working. 11—Hardness. 12—Corrosion. 13—Metallurgy (i) macrostructure, (ii) microstructure. 14—Design. 15—Effect of pitch and current shunting. 16—Shop practice.

The Welding of Non-ferrous Metals, by E. G. West. (*Transactions of the Institute of Welding*, April, 1941, Vol. IV, No. 2, p. 76, 2 figs.).

The main object of this review has been to present as complete a picture as possible of the present position of non-ferrous metal welding and its problems. The review makes no claim to include all the works dealing with any particular aspect of the subject and the scarcity of published information specifically on the non-ferrous metals is obvious. A number of elementary articles and papers of general interest have been included, and the author believes that nothing of importance published up to the end of 1939 has been omitted.

Resistance Welding Zinc-alloy Die Castings, by R. T. Gillette. (*The Welding Industry*, May, 1941, Vol. IX No. 4, p. 92, 6 figs.).

Zinc die-cast alloys can often be successfully welded provided that the correct equipment is used, the material thoroughly cleaned, and the resistance welding methods employed kept under strict control. It is considered that costs may be reduced by the aid of resistance welding in the fabrication of various structures.

Welded T-sections, by Dr. Gottfeldt. (*The Welding Industry*, May, 1941, Vol. IX, No. 4, p. 83, 12 figs.).

T-sections are mainly used as compression members of trusses. For small forces rolled T-sections of half-sections may be employed. The scope of these is, however, rather limited, not only by their relatively small areas but especially because their shape is far from being ideal, the most economical section being that for which the moments of inertia for the two main axes are equal. T-sections can be fabricated by welding a vertical flat, forming the stem, to a horizontal one forming the flange. Welded T-section. Method of increasing the moments of inertia of a T-section without increase in weight. Danger of local buckling when plates are too thin. Triangular gusset plates do not prevent local failure (twisting). Alignment chart showing relation between compressive force W , buckling lengths l_x and l_y , and dimensions of welded T-section. T-section suitable for combined compressive and direct stresses. Alignment chart showing relation between compressive force W , bending moment M , buckling length l , and dimensions of T-section. Numerical example for T-section under combined direct and bending stresses.

Modern Soldering Practice. (*Machinery*, May 15, 1941, Vol. 58, No. 1492, p. 182, 8 figs.).

Analyses of British standard soft solders. Use for which the solder is primarily intended. Tin per cent. Antimony per cent. Lead. Impurities.

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Aluminium or zinc. Iron. Arsenic, Fluxes. Diagrams showing sections of flux-cored tubular solder. Method of heating a plain copper bit electrically. Combined solder and flux. Soldering bits. Runbaken automatic soldering iron. Electric soldering bits. Chapman dip soldering machine for armatures. Dip soldering. Electrode soldering. Diagram illustrating the principle of electric soldering.

WELFARE, ACCIDENTS.

Psychological Factors in Accident Causation, by C. A. Oakley. (*The Journal of the Institution of Production Engineers*, May, 1941, Vol. XX, No. 5, p. 119).

The value of the individual's personal "defence mechanism" is mentioned, and a psychological analysis of why men have accidents is made. Safety habits and accident proneness are considered in detail, and the paper ends with a section devoted to "Stupidity and perversity." The discussion covers a very wide field of accident causation, including psychological and environmental factors.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

BELTS AND ROPES.

Short Centre Belt Drive, by H. M. Sherwood. (*The Australasian Engineer*, April 7, 1941, Vol. 41, No. 299, p. 18, 2 figs.).

The Lenix drive. The V-rope drive. The pivoted type of motor bases for short-centre drives. The Idler drive. The latest development in short centre drives "Cradle-torque." The principle of this drive differs entirely from other short centre drives. In "cradle torque" the motor is mounted entirely on its own base in a cradle which is supported on bearings, this cradle being free to rotate. The relationship of the distance between the centre of pins supporting the cradle and the motor shaft centres regulates the amount of torque pull placed on belt to hold motor from rotating. In this drive the off-setting of motor centres and cradle base centres have been so calculated that allowing a normal coefficient of friction there will be sufficient tension to transmit any load to which the motor may be subjected without belt slip. The cradle torque drive can be used on any drive regardless of angle or direction of drive.

COOLANT, LUBRICANT.

Cutting Oils, by O. L. King. (*The Tool Engineer*, May, 1941, Vol. X, No. 5, p. 53, 1 fig.).

Proper selection and use of cutting oils is necessary to economical production. The subject of cutting oils necessitates the discussion of lubricants, lubrication and all of the properties, adhesion, cohesion, film strength, dispersion, surface tension, polarity, capillarity, creep, fluidity, stability and rust preventing properties. Cutting oils should be finely divided. Fluid film. Dispersion. Use of additives. The application of the cutting oil to the point of the tool in a sizable stream is desirable.

Oil Cooling: Its Relation to Bearing Life, by R. A. Watson. (*S.A.E. Journal*, February, 1941, Vol. 48, No. 2, p. 41, B.N.F. Serial 23, 481).

Describes field and laboratory investigations of the factors causing high bearing and oil temperatures (and hence leading to bearing failure and gives details of various methods of cooling lubricating oil, 82° C. or less is recommended).

(Communicated by the British Non-Ferrous Metals Research Association).

Solving the Substitution Problem in the Oil Industry, by W. Hochuli. (*A.M.A. Marketing Series*, No. 41, p. 16).

The way to guarantee to the motorist that he was getting what he asked for and what he paid for. The only foolproof package was one that would be

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EMPLOYEES, WORKMEN, APPRENTICES.

Apprentice Record Cards, by O. L. Harvey. (*Personnel, May, 1941, Vol. 17, No. 4, p. 234, 3 figs.*).

The increased attention currently being given to apprenticeship as part of the national defence programme has resulted in a number of requests for technical advice and assistance in setting up a filing system for the recording of apprentice progress. It is one of the functions of the Apprenticeship Unit of the U.S. Department of Labour to provide this technical assistance.

Labour Relations of 1941—Co-operation vs. Dictation, by R. B. Hersey. (*Personnel, May, 1941, Vol. 17, No. 4, p. 270*).

The anti-strike formula. Drawing on the results of extended studies in the United States and Europe, the author outlines certain principles and practices which it is said will reduce work stoppages to negligible proportions.

FOUNDRY, MOULDING, MELTING.

Sand Control in the British Foundry Industry, by J. J. Sheehan. (*Trans. Amer. Found. Association, June, 1941, Vol. 48, No. 4, p. 766*).

A summary of the present position of sand control in this country. Historical development, technical committees and their objectives; advance made; national importance of the subject. Discussion.

(Communicated by the British Non-Ferrous Metals Research Association).

Economies in White Bearing Metals, by C. C. Downie. (*Chem. Age, April 5, 1941, Vol. 44, No. 1, 136, p. 195*).

A discussion of the use of scrap material in the manufacture of white bearing metals: suitable types and sources of scrap effects, detection and removal of undesirable elements (Zn, Al, Fe, As, etc.); melting procedure.

(Communicated by the British Non-Ferrous Metals Research Association).

GEARING.

Gear Tooth Loading—IV., by A. B. White. (*Power Transmission, June, 1941, Vol. 10, No. 113, p. 203*).

Calculation of tooth strength. (1) Helical gears. (2) Straight tooth bevel gears.

MACHINE ELEMENTS.

Couplings and Clutches for Power Plant Machinery. (*Eng. and B. H. Rev., May, 1941, p. 352*).

This article gives particular prominence to the problems connected with the alignment of shafts in power plant drives, and formulae are derived for correcting misalignments. The features and characteristics of a wide range of couplings for turbo-alternators and auxiliary drives of all kinds are dealt with to some length.

Fabric Bearings. (*Proctor. Mech. World, May 30, 1941, p. 369*).

The question of lubrication is considered and it is stated that bearing pressures up to 6,000 lb. per sq. in. have been dealt with successfully by suitable lubrication with water and grease. For light loads graphitic impregna-

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PRODUCTION ENGINEERING ABSTRACTS

tion without external lubrication may be employed. Mention is made of the application of fabric linings to footstep and collar thrust bearings.

Ball and Roller Bearings in Electric Motors, by B. Pringle. (*Mechanical World*, June 20, 1941, Vol. CIX., No. 2842, p. 417, 13 figs.).

Operating conditions : (1) The highly finished working surfaces must not be damaged. (2) The mounting must be correct, the seatings being truly circular, of the correct size and with square retaining shoulders. (3) The lubrication must be adequate and the bearing must be clean. (4) The design of the bearing must be suitable for the speed and loading. Possible troubles. Errors of mounting. Lubrication. Effect of water and acid. Cage wear.

MACHINING, MACHINE TOOLS.

Troubles Experienced with Automatics—their Causes and Cure, by E. E. Flusckey. (*Machinery*, June 19, 1941, Vol. 58, No. 1497, p. 313, 4 figs.).

The common causes of trouble have been collated and summarised with the object of enabling operators more readily to diagnose the particular cause and apply the corrective treatment with a minimum of delay. The importance of cleanliness. Bar ends should be chamfered. Forming tool troubles. Rake on form tools. Troubles arising from variations in length. Eccentricity of drilled holes with the outside diameter. Reaming. Turning tool troubles.

Surface Broaching. (*Automobile Engineer*, May, 1941, Vol. XXXI, No. 410, p. 153, 3 figs.).

Certain advantages may be secured on suitable components. Comparative costs are discussed and percentage savings effected in capital costs, labour costs, and tool costs on two automobile components are stated. Outline of the elements of broach design, including tooth form, tooth pitch and rise, also the elements of broach manufacture. Reference is made to the fundamentals of fixture design and an example of a successful fixture is given. Finally, there is the data to be employed in establishing the stroke, power capacity, and type of machine required for any specific job.

MANUFACTURING METHODS.

Finishing Shells by Centreless Grinding, by L. E. Mehlope. (*Machinery*, June 5, 1941, Vol. 58, No. 1495, p. 263, 13 figs.).

Centreless grinder equipped with Servo hydraulic "in feed" attachment and a magazine from which the shells are pushed automatically into the wheel throat. Operations on 20 and 25 millimetre aircraft shells. Finishing the bourrelet and ogive on 47 millimetre shells. Centreless grinder equipped with rails on which a shell is pushed into the wheel throat by a device with a bayonet lock for holding the work in the grinding position.

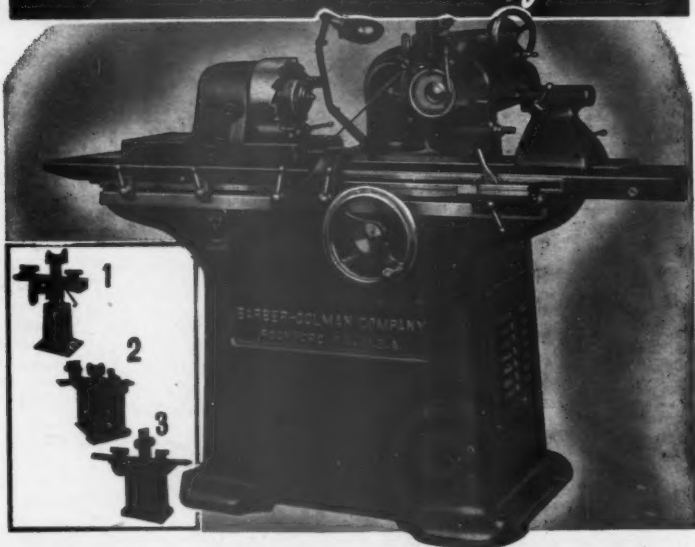
The Whitley Bomber in Production. (*Machinery*, June 5, 1941, Vol. 58, No. 1495, p. 253, 20 figs.).

Methods employed to secure quantity and quality in output. Press shop operations. Scalloping channel material. The production of stiffness. Bending and setting angle members. Setting fuselage formers.

The "Whitley V" by B. Foster. (*Aircraft Production*, June, 1941, Vol. III, No. 32, p. 194, 26 figs.).

Part I : Quantity production of bomber aircraft, building the main planes, box spar construction, one-piece wing assembly.

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PRODUCTION ENGINEERING ABSTRACTS

Production Engineering, by Earle Buckingham. (*Mechanical Engineering*, June, 1941, Vol. 63, No. 6, p. 431, 1 fig.).

The problem of production engineering has three major phases. First, the preparation for and the starting of the production of a new product or of a major change in the design of an existing product. Second, the orderly and effective operation of the plant in the continuing production of the product. Third, the continuing and supporting activities that gather information and put it into effective form for its direct application to the two preceding phases. Detailed discussion of all essential items.

Automatic Riveting in Aircraft Construction, by C. H. Plock, Luftwissen (Germany), Vol. 8, No. 2, February, 1941, p. 36). (R.T.P. Translation, No. 1190.)

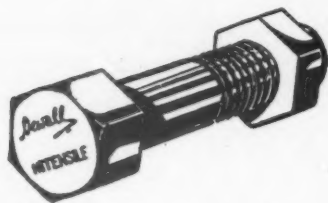
The article deals with flush riveting as practised by the Focke-Wulf Co. Such rivets can either be of the mushroom or flat head type. In the former the rivet is inserted from the inside and the countersunk head produced from the rivet shaft previously cut to the exact length to produce a flush fit in the dimpled sheet. The flat head rivet is inserted from the outside, the closing head being produced on the inside without requiring exact dimensioning of rivet length. In plates over 1.2 mm. thickness, the countersink is normally produced by a special tool akin to a milling cutter, the operation being usually combined with the drilling of the rivet hole. For thinner plates the necessary deformation for the countersink is produced mechanically (dimpling) either by the rivet itself or by means of special tools. If a thin outer skin is to be attached to a thicker plate, the latter is machine countersunk whilst the former is pressed to shape, again either by the rivet itself or by a special tool prior to insertion of the rivet. Dimpling by means of the rivet is more economical but the special tool furnishes a smoother surface. In the simple riveting machine the operation is limited to the closing of the rivet, either by gradual pressure (air, oil or a combination), a single blow or multiple blows. A semi-automatic riveting machine continues insertion with dimpling and clenching in one operation. An "automatic" riveter includes drilling the hole whilst a fully automatic machine also incorporates a work feed. It is also possible for the machine to manufacture the rivets as wanted by cutting off suitable lengths of wire carried on a reel. Representative type of semi and fully automatic machine are illustrated, and an interesting optical device for facilitating alignment of rivet with previously drilled holes is described.

Whilst the simple closing press requires but little operative skill, automatic riveting machines are much more delicate and trained personnel is essential. In the author's opinion, however, the saving in time is such that the high first cost of the automatic is well worth while.

(Communicated by D.S.R., Ministry of Aircraft Production.)

Efficient Design. (Luftwissen, Germany, Vol. 8, No. 2, February, 1941, p. 48.).

In the past, production has been increased by employing more labour and working longer hours. Much can, however, be done by efficient design, which not only makes the labour more productive, but also saves valuable material. Thus the Dornier works make considerable use of welded steel fittings for wings. Previously such fittings were made of die forgings, and in an example illustrated the original forging weighed .65 kg., reduced to .28 kg. after machining. By altering the design so that the flange consisted of two portions welded together, the quantity of material required was reduced to .20 kg., whilst the time taken to produce the finished article was 40% less. Tests have conclusively proved that such welded fittings are fully equal to the



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PRODUCTION ENGINEERING ABSTRACTS

original product machined out of the solid. Another big saving in time and material can be brought about by the substitution of pressings for previously riveted wing ribs.

It is stated that by introducing 30 small design improvements of this type in a certain aircraft 90 man hours were saved in labour, and the finished machine weighed 42 kg. less, combined with a further saving of 64 kg. in material utilised.

(Communicated by D.S.R., Ministry of Aircraft Production.)

Machining Operations on Aero Engine Valves. (*Machine Tool Review*, March-April-May, 1941, Vol. 29, No. 177, p. 3, 6 figs.).

Sodium-filled exhaust valve. Rough machined valve prior to the swaging operation on the stem. Radiusing attachment on a small-piece lathe for profiling under the head of the valve. Tool layout for machining the bore of the stem. Dial indicator set-up for checking concentricity of the bore. Tool layout for profiling the head of the valve.

MATERIALS, MATERIAL TESTING.

Tubing v. Bar Stock, by Hal. H. Strouse. (*The Machinist*, June 7, 1941, Vol. 85, No. 11, p. 153, 1 fig.).

"What material shall we use?" This question raises a choice of form as well as kind. For certain products the use of tubing has distinct advantages. seven separate savings were affected by changing from bar stock to tubing in machining an internally splined sleeve.

Material Investigations on Steel Fittings and Structural Parts of Some Captured British, American and French Aircraft, by H. Cornelius. [*Luftwissen (Germany)*, Vol. 8, No. 3, March, 1941, p. 78].

The steel parts examined were taken from the following aircraft:—

British: Blenheim, Wellington, Hampden, Battle, Spitfire;

U.S.A.: Hudson;

France: Morane, Liore-Olivier;

and covered wings, fuselage, engine supports, landing gear and armour plating. Attention is called to the extensive use of high alloy Ni-Cr-Mo steels by the British and French. According to the author, equivalent performance can be obtained without Ni, and the resulting Cr-Mo steels have the additional advantage of being weldable. This is the German and also the American practice. It appears that welding is still not favoured by the British designer.

British armour plate varies in thickness from 4.3 to 9.3 mm., with high Ni content (3.1 to 3.9%). The Fairey Battle used a non-magnetic Mn steel which is totally unsuitable for armour plating on account of its brittleness under bullet impact.

(Communicated by D.S.R., Ministry of Aircraft Production.)

Material and Design of Some Captured British, American and French Aero Motors, by P. Kotzschke. [*Luftwissen (Germany)*, Vol. 8, No. 3, March, 1941, p. 69].

The motors examined covered the following types:—

British: Merlin, Mercury, Hercules, Tiger;

French: Hispano Gnome-Rhone;

U.S.A.: Cyclone, Twin Wasp.

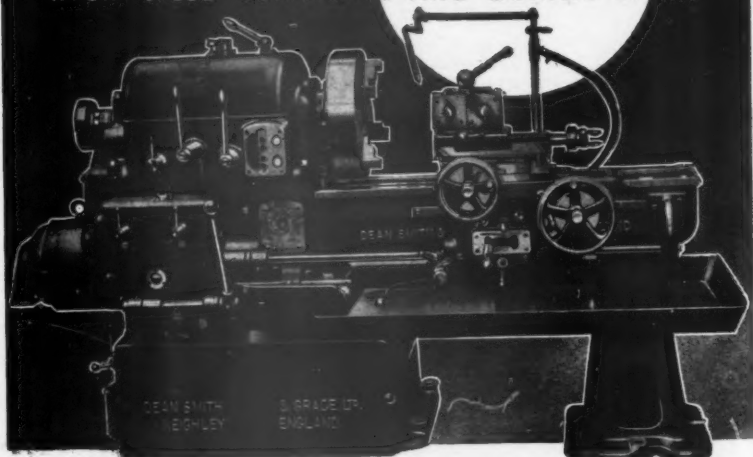
All the highly stressed parts (crankshaft, connecting rods, bearings) were carefully examined as to composition and heat and surface treatment. The

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survey also included cylinder liner, piston rings, valves, valve seating, springs, gears and cylinder belts. A special section is reserved for light alloys (pistons cylinder heads and crankcase) (the Cyclone crankcase is made of steel). Special attention is called to the French process of die casting cylinder heads, which is described in some detail. The author is of the opinion that British and French designers use needlessly complex alloy steels containing varying proportions of Cr, Ni and Wo, etc. Low alloy steels give equivalent performance, as is also recognised by America. Whilst nitriding appears to be more common than in German designs, the author considers the surface finish generally below the German standards.

(Communicated by D.S.R., Ministry of Aircraft Production.)

Aircraft Plywood, by T. D. Perry. (*Aircraft Production*, June, 1941, Vol. III, No. 32, p. 221, 7 figs.).

Improvements resulting from the use of modern phenolic resin adhesives. Moulding processes for aircraft units.

New Uses of Elektron Sheet : Methods of Overcoming Difficulties of Manipulation, by D. B. Winter. (*Aircraft Production*, May, 1941, Vol. 3, No. 31, p. 153).

When elektron is used instead of an Al alloy, changes in design and manipulation are required if the elektron is to give good service. Author discusses designing, hot working, protection against corrosion, welding and riveting, giving examples from aircraft production.

(Communicated by the British Non-Ferrous Metals Research Association.)

MEASURING METHODS, APPARATUS.

The Application and Use of Quartz Crystals in Telecommunications, by C. F. Booth. (*Journal of the Institution of Electrical Engineers*, June, 1941, Vol. 88, Part III, No. 2, p. 97, 63 figs.).

Some of the more important applications of the quartz crystal in the telecommunication art. In particular, the applications of both quartz oscillators and resonators by the Radio Branch of the Post Office are outlined and the performance of representative equipments incorporating crystals is described.

(1) The scope of the paper, the quartz crystal and a standard nomenclature. (2) Quartz oscillators and their application to frequency control. (3) The quartz resonator and some of its uses in frequency measurement and frequency selection. (4) The production of quartz oscillators and resonators.

Effect of Temperature on Coiled Steel Springs Under Various Loadings. (*P.P. Simmerli Trans. A.S.M.*, Vol. 63, No. 4, May, 1941, p. 363).

1—The usual spring steels are reliable when stressed 80,000 psi or less up to temperatures of 350°F. Between 350°F. and 400°F. and at stresses up to 120,000 psi, the same continuity of results is lacking, but with proper forethought some commercial success might be expected. 2—The use of ordinary spring steels over 400°F. is not possible. 3—Steels, hardened and tempered after coiling into springs, at the same hardness value, have no advantage over springs made of pretempered wire properly blued, under the conditions investigated. 4—Stainless steel of the 18-8 type resists temperature and stress better than other spring steels, except perhaps high-speed steel. 5—A middle hardness range in quenched-and-drawn springs is preferable to either high or low ranges. 6—An optimum temperature to heat springs after coiling for heat resistance is the highest one which will not render the hardness or



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other physical properties of the material objectionable. 7—The present Swedish valve-spring wire stands heat very poorly, in fact, is less satisfactory than many other steels. 8—Both high manganese and silicomanganese steels equal the chrome-vanadium steel tested, and may have commercial advantages.

(Communicated by D.S.R., Ministry of Aircraft Production).

The Dynamic Absorber and its Application to Multi-Throw Crankshafts, by Bailey and Bullied. (*Journal of Institute of Mechanical Engineers, May, 1941, p. 73*).

The dynamic absorber is stated to be the special case of a tuned absorber in which the natural frequency of oscillation is directly proportional to the rotational speed of the shaft which carries it. Four typical absorbers are studied in detail. In each case the tuning and amplitude equations are derived and, for the roller types, expressions are obtained for the maximum roller amplitude which may be attained without the occurrence of slipping. It is stated that the method is quite general, and can be applied to any other type of engine as desired.

(Abstract supplied by Research Dept., Metro-Vickers.)

Standard American Acceptance Tests for Machine Tools. (*Machinery, June 12, 1941, Vol. 58, No. 1496, p. 290*.)

To-day the prevailing demand is for machines operated by unskilled male or female labour, which must be able to turn out work correct in shape and dimensions, completely interchangeable, and ready to pass the severest inspection. The American National Machine Tool Builders' Association in Cleveland have published their first standards of accuracy for engine lathes for (1) toolroom lathes, (2) medium engine lathes from 12 in. to 18 in. swing, and (3) larger sizes from 20 in. to 36 in. The American Standards are compared with those used mostly by the users of this country. Great accordance in tests and admissible tolerances are stated, and an Anglo-American co-operation is recommended.

PHOTOGRAPHY (FILM, X-RAYS, ETC.).

A New Use for X-Rays in Industry. (*Woods and Kenner Electronics, April, 1941, p. 29*).

Particulars are given of an industrial process which uses the ionisation of air caused by the presence of X-rays to pass a minute current which controls a pass-or-reject relay. This new process is automatic in operation and it is suggested that for inspection of large numbers of articles it will prove more efficient and practical than the normal visual fluorescent inspection methods. The apparatus described is stated to be readily capable of inspecting 1,400 table knives an hour.

(Abstract supplied by Research Dept., Metro-Vickers.)

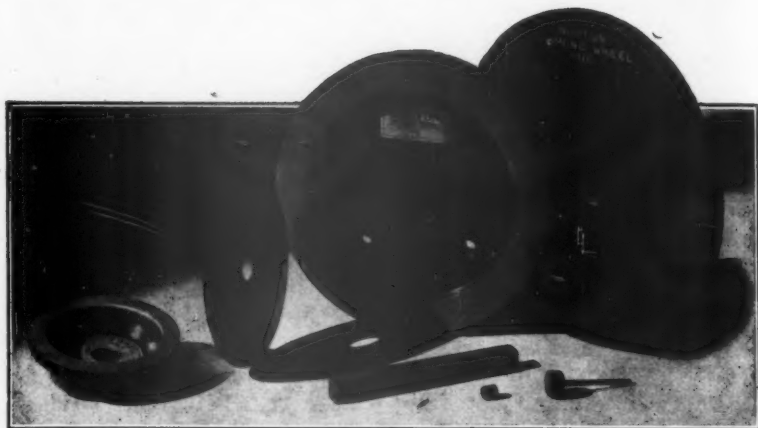
X-Ray Analysis in Industry. (*Journal Science Institute, May, 1941, p. 69*).

This issue contains the first part of a symposium on X-ray analysis in industry, sponsored by the Institute of Physics. The industrial applications of X-ray analysis form the subject matter for the 10 papers in this section, and included are such titles as "Some Application of the X-Ray Powder Method in Industrial Laboratory Problems," "An X-Ray Examination of Mechanical Wear Products," and "Some Examples of Industrial Testing of Materials by X-Ray Diffraction."

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PSYCHOLOGICAL INVESTIGATION.

A Study of the Development of Skill During Performance of a Factory Operation, by R. M. Barnes, and J. S. Perkins. (*Transactions of the A.S.M.E.*, May, 1941, Vol. 63, No. 4, p. 319, 10 figs.).

Time study of the elements entering into the performance of an industrial task. The investigation constitutes a pioneer effort to study the effect of practice on a typical factory operation, conducted under laboratory conditions. The work was undertaken jointly by the Western Electric Co. and the University of Iowa. As an example the operation of feeding parts to a punch press was chosen. Learning curves. Interpretation of results.

A Study of the Development of Skill During Performance of a Factory Operation, by R. M. Barnes and J. S. Perkins. (*Trans. A.S.M.E. (U.S.A.)*, Vol. 65, No. 6, May, 1941, p. 319).

While in general the many studies into the nature of skill have been concerned with the total time required to accomplish a given task and their influence on time values of varying conditions pertaining to a specific operation, this paper is primarily devoted to a time study of the elements entering into the performance of an industrial task. The investigation constitutes a pioneer effort to study the effect of practice on a typical factory operation, conducted under laboratory conditions.

The various aspects of the study on which information was sought are as follows: 1—The effect of practice on a typical factory operation carried on under laboratory conditions. 2—The learning curves of the various elements of the operation as they were performed by each of the different subjects. 3—The consistency between subjects in learning the same element. 4—The effects of "speeding." 5—The dispersion and its relation to the average performance time. 6—The effects of fumbling on the normal learning curve. 7—The several ways in which a transport load and pre-position element was performed. 8—The effectiveness of several rating techniques on data of known quality. 9—The effect of practice on the relation of eye movements to hand motion.

Summing up the discussion, the paper seems to prove the desirability of establishing time standards from data as compared with individual time studies, and indicates that jobs should be planned to avoid, as much as possible, conditions which might cause fumbles. Two-thirds of the improvement noted was in the elimination of fumbling, and one-third was due to faster movements and better co-ordination.

(Communicated by D.S.R., Ministry of Aircraft Production).

SHOP MANAGEMENT.

Successful Rate-fixing and Planning by Co-operation, by John McHale. (*Mechanical World*, June 13, 1941, Vol. CIX, No. 2841, p. 410).

How the team spirit can be invoked to the mutual benefit of management and personnel. Securing co-operation. Causes of failure. A practical example. Confusion and suspicion. Rate-fixing and timing. Properties of human material. Results.

SMALL TOOLS.

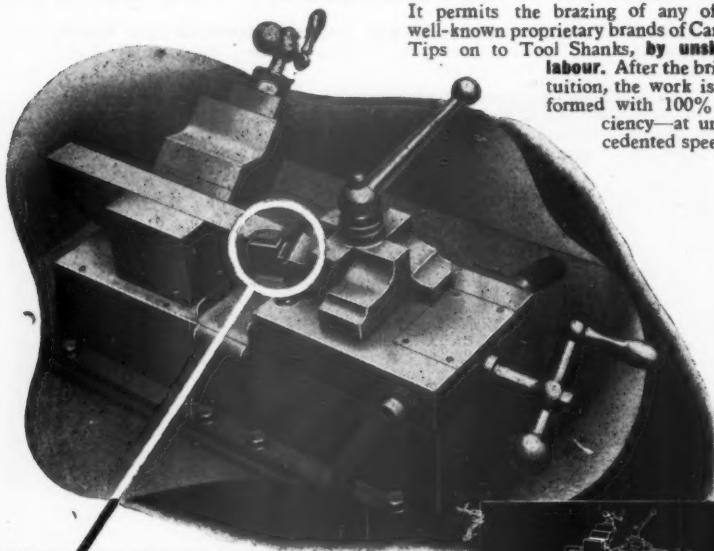
Tooling Set-ups for High Explosive Shell—III, by Ben. C. Brosheer. (*The Machinist*, June 7, 1941, Vol. 85, No. 11, p. 163, 32 figs.).

Tooling Set-ups for High Explosive Shell—IV. (*The Machinist*, June 28, 1941, Vol. 85, No. 14, p. 227, 34 figs.).

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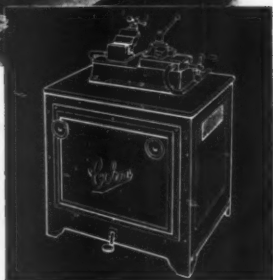
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Longer Tool Life, by C. A. Hooper. (*The Tool Engineer*, May, 1941, Vol. X, No. 5, p. 44, 10 figs.).

A tool must first be of proper design. It must, secondly, be a tool of reasonable long life. It should produce work to a high degree of accuracy over a long period of time without sharpening. Examples of cast high-speed steel: Briquetting chambers. Grinder work rests. Hobs for gear cutting. Molybdenum lathe tools. Types of milling cutters. Salvage. Types of core drills for rough drilling crankpin hole in connecting rod. Reversible side milling cutter. Four-diameter twist drill.

Economics of Cemented Carbides on Variety Production, by C. D. Mackinnon. (*Machine Shop Magazine*, June, 1941, Vol. 2, No. 6, p. 62, 7 figs.).

Selecting the machine. From the viewpoint of profits and high production, the machine selected must have ample power for the duty which will be imposed on the tool. Machines which are more or less obsolete and which have no reserve of power beyond that required for the successful operation of high-speed steel tools are not suitable for carbides. Straight tungsten carbide alloys, i.e., carbides which do not contain titanium, tantalum or molybdenum, will be found to give best results where absence from vibration or chatter cannot be guaranteed. Machining cast-iron on a lathe. Machining steel. Tipping the tools. Slice for applying flux. Grinding carbide tips. Hooked rod for spreading flux. Care of tools. Salvage of carbide tips. Much useful work can be performed by fractured tips and small pieces of what would seem to be scrap carbide. Diamond wheels are seen at their best on salvage work. Tool blank milled out to receive fragments of tip. Broken tip in place for brazing. Selection of carbides is of vital importance, if complete success is to be enjoyed.

Can't Use Carbides: by W. J. Burger. (*The Machinist*, June 21, 1941), Vol. 85, No. 13, p. 218, 12 figs.).

Many men think that carbide tools are useful only on mass production. The Warner & Swasey shop made them work on small lots. Many examples are illustrated.

SURFACE TREATMENT

Clad Metals. (*Automobile Engineer*, May, 1941, Vol. XXXI, No. 410, p. 157, 2 figs.).

The homogeneous attachment of dissimilar metals over large surfaces is a comparatively recent development. Very wide spheres of utility are opened up for really reliable processes. Electrochemical cladding. Anodic pickling. The welding process. Stainless irons. High-speed steel. Stellite cladding. The backing material used in most cases will probably be ordinary low-carbon steel. Bath of molten copper-lead used for coating mild steel strip. Method used by Ford Motor Co. for making copper-lead bearings. Heavy-duty bearings of bi-metal plates. Lead-bronze bearings. Cladding by spray. Sprayed bronze. Cadmium-silver-copper. Oxygen cutting. Cutting stainless-clad plate. Cutting nozzle size.

Surface Finish. (*Aircraft Production*, June, 1941, Vol. III, No. 32, p. 209, 10 figs.).

Honing: types of tools. Aero-engine cylinder barrels. Operations on master connecting rods. The use of the hone abrading process as a final operation, and its application to the aircraft industry. The value of honing lies in the fact that four operations are combined in one; comparatively large amounts of stock may be removed, very accurate sizing achieved, errors of roundness and straightness corrected, and a surface finish of a good quality



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PHOTOGRAPH: First operation in rough turning and facing piston of hiduminium R.R. 59 aluminium alloy The Herbert No. 4 lathe is cutting at 500 r.p.m. and feeding COOLEGE water soluble cutting oil as a one in 20 emulsion. [Courtesy the DE HAVILLAND AIRCRAFT CO. LTD., Edgware].

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PRODUCTION ENGINEERING ABSTRACTS

obtained. Reference is made to the various types of tools and machines used, and illustrations of many special-purpose fixtures are given.

TECHNICAL EDUCATION.

Vestibule Training for To-day's Needs, by L. J. Smith. (*Personnel*, May 1941, Vol. 17, No. 4, p. 247).

Vestibule training is a method of training a large number of employees, primarily in unskilled or semi-skilled work, in a relatively short period of time. This is done with the least amount of disturbance to the regular flow of production and to the routine of the trained working force. Factors to be considered in installing. Evaluation of vestibule training. The value of the vestibule training method is greatest where there are large numbers, of men to be trained on unskilled or semi-skilled machine or mass-production operations in a relatively short period of time.

TRANSPORT, TRANSPORT EQUIPMENT.

Permeability of Fibre Containers to Water Vapour, by W. E. Emley. (*A.M.A. Marketing Series*, No. 42, p. 42).

One of the important properties of a container is to protect the goods against damage in shipment and against any deterioration which may be caused by climatic conditions. The atmospheric agent which causes most worry is water. For the ordinary kinds of goods which naturally contain a certain amount of water, it is necessary only to prevent them from drying out or getting too moist. Water content. Vapour pressure. Paper liners. Effect of water on container. Problems in waterproofing. Lack of knowledge on relative abilities. The first step in the solution of the problem is to make an intensive survey of the field, to develop, adapt, select, or in some way get a set of testing methods. These should be designed to measure the relative abilities of different kinds of containers to protect the contents during shipment and storage.

Effect of War on British Packaging, by I. M. Sieff. (*A.M.A. Marketing Series* No. 42, p. 33).

Wartime restrictions. The war picture by American eyes. Regulation of trade. Quota system. Control of retail prices. Control of raw materials. Limitations imposed on packaging. The need for simplification.

WELDING.

The Modern Electrode, by W. Andrews. (*The Welding Industry*, June, 1941, Vol. IX., No. 5, p. 109).

A survey of recent developments. Materials. Economic and technical aspects. Mild steel electrodes. Early flux coatings. The spiral wound extrusion process. Use of silicates and fluorides. Exclusion of oxygen and nitrogen. Value of titanium oxide. Use of forms of cellulose. Basis of modern electrode. High quality electrodes. Gas-shielded electrodes. Heavy gauge electrodes. Standard lengths. Future developments. Automatic welding.

Gas Welding of Magnesium Alloys, by T. Jefferson. (*The Welding Industry*, June, 1941, Vol. IX., No. 5, p. 117, 4 figs.).

Welding characteristics. Joint preparation. Welding difficulties. Flux Filler rod. Welding procedure. Weld cleaning.



No. 12 DIE CASTER for zinc base alloys.
Capacity $12\frac{1}{4}'' \times 12\frac{1}{4}''$

DIE CASTING 'DILUTION'

BRUTE force is not necessary in the operation of E.M.B. Die Casters. Many girls of quite ordinary physique are getting maximum output from them.

The pneumatic system of the die carriage does all the hard work ; the actual manual control is extremely light and sensitive.

Here then is the solution to one dilution problem.

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The wide experience of our specialist is at your disposal.

E.M.B. Co. Ltd.
WEST BROMWICH, ENGLAND

PRODUCTION ENGINEERING ABSTRACTS

WELFARE, ACCIDENTS.

Good Advice to New Munition Workers. (*Machine-Tool Review, March April-May, 1941, Vol. 29, No. 177, p. 21, 13 figs.*).

Some hints on accident prevention and care of machines. Correct dress for women operators—tight-fitting cap, short sleeves, no loose clothing, low-heeled shoes. How not to dress—loose hair, long sleeves, bangle, ring. It is quite unnecessary to rest the hands on the machine. The result of wearing long sleeves when operating a drilling machine. Beware of old or defective tools. Don't remove turnings with the hands. Use a rake. Never feel tools or work in motion. Don't use rag or waste to clean revolving work or tools. Use a brush. Grinding wheels are dangerous. Work well away from them. Spanners should not be used as hammers. The result of leaving loose tools on the headstock and slides of the machine.

Clothes for Women Workers. (*Industrial Welfare and Personnel Management, June, 1941, p. 125, 2 figs.*).

Supply of overalls (a) free. (b) part payment by employee. (c) Buying at cost price from the firm. Laundering and repair : (a) free ; (b) payment by employees. Types of overall. Caps. Colour and design. Net cap to hold curls. Limitation of supplies. Cloth cap for dirty processes.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

ACCOUNTING, ADMINISTRATION.

Today's Selling Problems in the Industrial Field, by E. O. Shreve. (*Marketing Series, No. 43, American Management Association, p. 8*).

Problems of sales groups. 1. Greater percentage of business originating from some governmental subdivision. 2. Scarcity of some types of raw material. 3. Delayed shipments with complication of application of priorities. 4. New companies with small capital with large volume of business. 5. Responsibility for regular commercial business and service to old, established customers. 6. Risk involved in large contracts with long deliveries on firm price bases. 7. Responsibility for helpful planning for postwar period. 8. Necessity for planning to take back men from military training. 9. Danger that careful training of sales force will be forgotten.

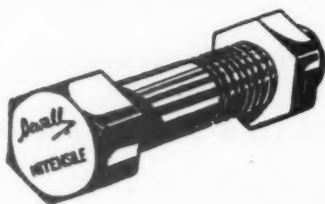
The 12 Most Important 1941 Sales Appeals. (*Marketing Series, No. 44, American Management Association, p. 31*).

On a separate chart, entitled, "The 12 Most Important 1941 Sales Appeals" are arranged (1) The most pressing problems in industry and business today. (2) How business paper advertising is helping to meet these problems. In column form under each major problem may be found headline and text quotation abstracted from those advertisements which best typified the 1941 appeals most frequently used. (3) Why these problems are important—their future—and what they mean to advertisers.

BELTS, ROPES.

High-Powered Belt Drives, by H. S. Jude. (*Power Transmission, July 15, 1941, Vol. 10, No. 114, p. 255, 3 figs.*).

By high-powered drives one means those drives which require large and stronger than ordinary belts to equip them, or those which need a special construction of belting designed to increase the power-delivering ability of the existing pulley equipment beyond the expected normal. Heavy leather belts. E = effective tension in lbs. per inch width is for: (1) Single leather, 50 to 55, (2) double leather, 100 to 110, (3) triple leather, 150 to 165. Insist upon pulleys large enough to permit easy flexing and proper contact. Hair belting. Pure camel hair of long staple. The weft (transverse) threads and also the binders, which keep the separate layers of cloth in the exact relative position to each other, are normally made of cotton. It is a wise precaution to specify 100 per cent camel hair warp threads. Hair belts can be woven to any desired width and thickness, so that practically any drive can be satisfied with this material for horse-power. Link leather: The amount of power these belts will deliver is not large. Compound belts combine two types of belting in the one



" NEWALL HITENSILE " **HEAT TREATED** **STEEL BOLTS**

have achieved their great success because they are manufactured by a firm whose experience in Heat-treating is unique. They are made from carefully selected steel and closely inspected at every stage of manufacture. The fact that the name appears on the head of every bolt is their guarantee that the highest quality will always be maintained.

A. P. NEWALL & COMPANY, LTD.
Woodside Engineering Works
POSSILPARK **GLASGOW, N**

PRODUCTION ENGINEERING ABSTRACTS

product : leather and rubber, leather and balata, and leather and hair are typical examples to increase the flexibility and to secure the maximum transference of power.

COOLANT, LUBRICANTS.

The Magnetic Filtration of Lubricating and Cutting Oils. (*Machinery* Lloyd, July 26, 1941, Vol. XIII, No. 15, p. 33, 4 figs.).

The most fruitful source of wear on bearings and other working surfaces is the presence of solid particles, which generally are metallic, in the lubricating oil. The particles giving the most trouble are those small fragments of iron or steel which contaminate the oil after being produced by wear from sliding parts. Therefore the extracting of these ferrous particles is most important. Philips Magnetic Filter. The contaminated oil passes across the air gaps formed by the rings surrounding the permanent magnet. The non-magnetic cover over this magnet prevents the particles from adhering to the magnet itself.

Deep Drawing Lubricants, by E. E. Halls. (*Automobile Engineer*, June, 1941, Vol. XXXI, No. 411, p. 192).

In press work, lubricants and their characteristics are of considerable importance. Special qualities are demanded in the various oils and compounds used for these purposes, and these are set out in full. Many compounds are dealt with and their compositions are set out in tabular form.

EMPLOYEES, WORKMEN, APPRENTICES, ETC.

Gun Manufacture with Female Labour. (*Machinery*, July 31, 1941, Vol. 58, No. 1503, p. 477, 13 figs.).

The training of women and the results achieved at a Royal Ordnance factory. Selection of employees. Training of operators. General training syllabus. Examinations for employees. Welfare work.

FOUNDRY MOULDING.

Production of Non-Ferrous Castings: A Comparison of Centrifugal, Chill and Sand Casting, by R. F. Hudson. (*Met. Ind.*, May 23, 30, 1941, Vol. 58, Nos. 21, 22, pp. 447, 469).

Procedure and relative merits of the three different casting methods; alloys which are suitable for the different methods; mechanical properties obtainable. Various Monel alloys, phosphor bronze, Al. bronze.

(Communicated by the British Non-Ferrous Metals Research Association)

MACHINING, MACHINE TOOLS.

Troubles experienced with automatics, their cause and cure—II, by E. E. Fluskey. (*Machinery*, July 17, 1941, Vol. 58, No. 1501, p. 429, 1 fig.)

Threading troubles. Tapping trouble. Knurling tools. Speeds and feeds for automatics. Cutting lubricants. Hourly production in relation to efficiency rating.

The Production of Grinding Machines. (*Machinery*, July 24, 1941, Vol. 58, No. 1502, p. 449, 11 figs.).

Methods employed by the B.S.A. Grinding Machine Co. Ltd., in building plain and centreless grinders. Assembly and testing. Equipment employed for aligning the table ways of the grinding machine. Chart showing alignment

Small parts with
BIG RESPONSIBILITIES

Automatic Feed
Spring Grease
Cup No. 14



Known and proved by sterling service in every branch of engineering, R. & S. parts are specified when quality and craftsmanship are decisive factors.

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PRESSURE GAUGE
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GREASERS
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Rotherhams
OF COVENTRY
PRECISION MANUFACTURERS
SINCE 1750

tests carried out on B.S.A.—Landis plain hydraulic grinding machines. Equipment employed for checking the table and wheel—head ways.

Longer Wear in Grinders. (*Nickel Cast Iron News*, 1941, Vol. 12, May, p. 2).

The following composition is recommended as giving maximum wear-resistance and strength in grinder ways: Total carbon 3.20 per cent, silicon 2.00 per cent, nickel 1.50 per cent, chromium 0.50 per cent, molybdenum 0.30 per cent. All castings are normalised after rough-machining. Tensile strength of the iron is satisfactorily high and the material has a Brinell hardness of about 235. The fine-grained and uniform structure of the iron permits of machining to a very smooth finish.

(Communicated by "The Nickel Bulletin.")

Surface Finish—II. (*Aircraft Production*, July, 1941, Vol. III, No. 33, p. 227, 8 figs.).

Multi-bore propeller shafts: hydraulic brake control units; oleo cylinders; combination boring and honing equipment: horizontal machines. A demonstration of the ease with which the stones of mechanically actuated tools may be changed. The sequence of boring and honing operations on blind-end oleo cylinders. Horizontal machines arranged for honing small bores. A twin-spindle horizontal machine arranged for external honing operations on a universal joint. Size control. External honing.

CHIPLESS MACHINING.

Effect of Burnishing on Fatigue Strength—I, by O. J. Horler. (*The Machinist*, July 26, 1941, Vol. 85, No. 18, p. 154E, 6 figs.).

Burnishing machine parts by passing a hardened roller under pressure over a surface or by pressing a ball through an undersize hole are old methods of obtaining smooth and wear-resisting surfaces. About ten years ago the first experimental evidence was submitted to show that burnishing also produced an increase in fatigue strength. Effect of surface rolling on rod. Photomicrographs showing structures obtained. Results of fatigue tests on shafts. Fatigue failure at fillet base.

MANUFACTURING METHODS.

Machining Zinc-Alloy Die Castings. (*The Machinist*, July 5, 1941, Vol. 85, No. 15, p. 259, 1 fig.).

Zinc alloys for die castings are comparatively soft (Brinell hardness from 57 to 113) and are free machining. High speeds and light cuts yield best results. Numerical data for drilling, tapping, threading, reaming, turning, milling and spot facing, broaching and shaving, sawing, grinding and polishing, chipless operations: (1) type of tool, (2) speeds (3) feeds (4) cutting angles.

The Whitley V, by Bruce Foster. (*Aircraft Production*, July, 1941, Vol. III, No. 33, p. 234, 27 figs.).

Part II. Building the fuselage: details and sub-assemblies: final assembly.

Tooling Set-ups for High Explosive Shell—V, by Ben. C. Brosheer. (*The Machinist*, July 19, 1941, Vol. 85, No. 17, p. 293, 35 figs.).

Girling Brake Production. (*Automobile Engineer*, June, 1941, Vol. XXXI, No. 411, p. 183, 19 figs.).

Detailed descriptions are given of the processes employed on the components comprising the adjuster and expander units. Production flexibility is attained

NORTON ABRASIVES

NORTON DIAMOND WHEELS



**ESSENTIAL FOR THE PROPER MAINTENANCE
OF TUNGSTEN CARBIDE TIPPED TOOLS**

IMMEDIATE DELIVERY

OBTAINABLE FROM

NORTON GRINDING WHEEL CO. LTD.

WELWYN GARDEN CITY, HERTS.

ALFRED HERBERT LTD.

OF

COVENTRY

PRODUCTION ENGINEERING ABSTRACTS

by means of jigs and fixtures specially designed to make standard machines into special single-purpose machines. Interesting methods to eliminate inspection and yet maintain a high quality of product are discussed. Surface broachin- plays an important part in the production of these brakes.

MATERIAL, MATERIAL TESTING.

Stainless Steels, by S. Hattersley. (*The Australasian Engineer*, May 7, 1941, Vol. 41, No. 300, p. 10, 10 figs.).

Types of stainless steel. Stainless steels which can be hardened by heat-treatment. Stainless steels which cannot be hardened by heat treatment. Intergranular corrosion. Resistance to corrosion. Surface condition of stainless steel. Tests for intergranular attack.

Tungsten—Its Production and Allied Metallurgical Applications, by N. Pett and D. E. Goss. (*The Australasian Engineer*, May 7, 1941, Vol. 41, No. 300, p. 18, 2 figs.).

Part I. The production by E. D. Goss. The world production of tungsten: Great Britain, France, Germany, Mexico, Russia, Australia. Production of tungsten powder. Flow sheet. The distribution of tungsten in industry. The reduction of the tungstic oxide. Manufacture of ferro-tungsten. The manufacture of cemented tungsten carbide. Explanation of the cementing action. Ductile tungsten.

Part II—The application by N. Pett. (1 Steel application. (2 cemented carbide applications. (3 Miscellaneous applications. Miscellaneous steels containing tungsten. Tungsten steels. Group 1. Silver steel types. Tungsten steels. Group 2. Finishing steels. Tungsten steels. Group 3. Shock resistant steels. Tungsten steels. Group 4. Hot working steels. Tungsten steels. Group 5. High speed steels.

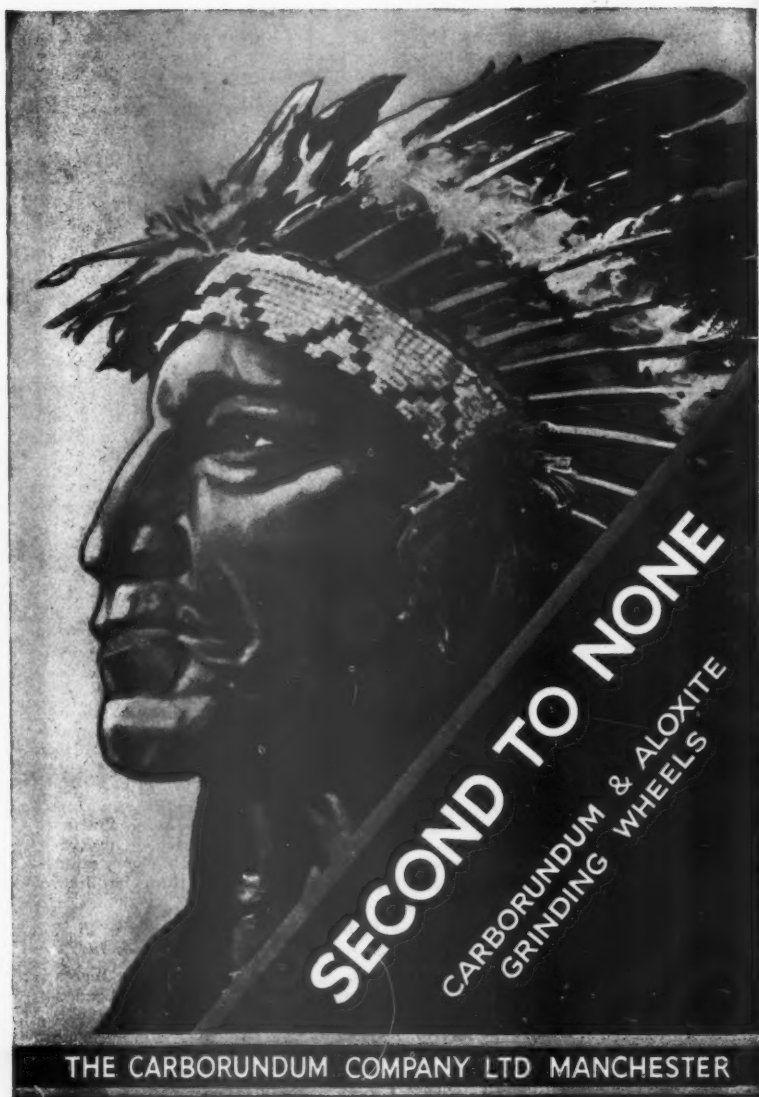
High-speed Tension Tests at Elevated Temperatures—Parts II and III, by A. Nadai and M. J. Manjoine. (*Journal of Applied Mechanics*, June, 1941, Vol. 8, No. 2, p. A77, 33 figs.).

The authors discuss the results of an investigation on the resistance to plastic forming of several metals over a wide range of rates of deformation at various temperatures. To carry out the tests, two machines were built: One, a high-speed testing machine, was described in Part I of this report, the other, a constant-strain-rate machine, is dealt with in this presentation. The general trend of the test results for aluminium and copper indicates a continuous increase of the yield stresses with the strain rate. The speed relation for pure iron and the iron alloys seems to be much more complicated. Observation data are furnished for an evaluation of the forces required for very rapid plastic forming of the metals at high temperatures, particularly through rolling.

Specifications for Lead Bronze. (*British Standards Institution—"B.S. Specifications for Lead Bronze Castings and Ingots*, Nos. 960 to 965, 1941).

The specifications relate, respectively, to 85-10-0-5 Lead Bronze Ingots (No. 960). 85-10-0-5 Lead Bronze Castings (No. 961). 80-10-0-10 Lead Bronze Ingots (No. 962). 80-10-0-10 Lead Bronze Castings (No. 963). 76-9-0-15 Lead Bronze Ingots (No. 964). 76-9-0-15 Lead Bronze Castings (No. 965). The compositional requirements in all cases include figures for maximum nickel content.

(Communicated by "The Nickel Bulletin").



SECOND TO NONE
CARBORUNDUM & ALOXITE
GRINDING WHEELS

THE CARBORUNDUM COMPANY LTD MANCHESTER

MECHANICS, MATHEMATICS.

Balancing rotating machinery, by F. C. Rushing. (*The Machinist*, July 26, 1941, Vol. 85, No. 18, p. 334, 8 figs.).

The dynetric principle. The dynetric balancer indicates location of an unbalance by the flashing of a stroboscopic lamp. Speed during operation is held constant at same speed between 1,000 and 2,000 r.p.m. Stroboscopic type balancer. Universal dynetric balancer. Crankshaft balancer. Field balancing.

PSYCHOLOGICAL INVESTIGATION.

Short Tests of Low-Grade Intelligence. (*Occupational Psychology*, July, 1941, Vol. XV, No. 3, pp. 107, 112, 120, 2 figs.).

I, by P. E. Vernon. II, by F. J. S. Esher, III, by E. L. Trist. In a series of articles three authors have discussed possible answers to the following question Assuming that group tests of intelligence have been used to cream off the average and above average members of a group of adults, what short methods of individual testing can then be used to determine fairly accurately the intellectual level of the remainder, and especially to detect mental deficiency? Particularly, what methods of individual testing can be used if the examining psychologist has only 15 minutes at his disposal, a period capable of extension in some cases by a further 5, 10 or 15 minutes?

SHOP MANAGEMENT.

The Engineer's Responsibility in Management, by T. H. Ross. (*Mechanical Engineering*, July, 1941, Vol. 63, No. 7, p. 524).

Good management has become essential to industry. What to do vs. how to do it. Management too often placed in incompetent hands. Shortage of skilled workers a handicap to engineers. Present emergency affords opportunity for engineers. Wastes in industry chargeable to mismanagement. Problem of a proper layout. Too few engineers in executive positions.

SURFACE TREATMENT.

Effects of Surface Finish, by J. T. Burwell, J. Kaye, D. W. van Nymegen and D. A. Morgan. (*Journal of Applied Mechanics*, June 1941, Vol. 18, No. 2, p. A49, 11 figs.).

Various commercial surface finishes are produced on steel shafts and in part I it is found that the finish has little effect on the operation of a journal bearing in the region of hydrodynamic lubrication but does markedly affect the load capacity. In part 2 a chemical method of detecting iron in oil is developed with a sensitivity of one part in ten million. This method is used to measure the iron removed during "running-in" from shafts with different surface finishes and under different loads. Methods of measurement. Apparatus. Experimental procedure.

The Chrome-Hardening of Cylinder Bores, by H. Van der Horst. (*Mechanical Engineering*, July 1941, Vol. 63, No. 7, p. 536, 4 figs.).

The purpose of chrome-hardening cylinders is to bring about a reduction in the wear of cylinders, piston rings, and piston-ring grooves. The ways are reviewed in which the application of chromium metal on the cylinder bore affects lubrication and choice of fuel. Method of application is dealt with that is, proper bonding to the base material and the properties of chromium

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metal as they are good or bad for this purpose. Comparison of wear of nitrided cast-iron cylinder bore with chrome-plated bore. Comparisons of wear of various cylinder bores. Breakdown test conducted. The application of chromium is not an easy job. The process must meet certain fundamentals : 1. The electrolytic coating must adhere perfectly. 2. The thickness of the coating must, within limits be equal all round and from top to bottom. 3. There must be no tiny ridges for the piston or the rings to run against. 4. The ordinary bright, dense coating of chromium is not suitable ; it does not hold lubricating oil. 5. In order to hold oil, it is essential that the chromium be very porous.

Plating for Life—Not Looks, by Raymond F. Yates. (*The Machinist*, July 26, 1941, Vol. 85, No. 18, p. 327, 6 figs.).

Hard chrome can be spectacular in extending the life of many tools. Only 0.0005 in. of chromium applied to the drawing area of a die boosted its production from 5,000 to 20,000 parts. Hard chrome plated on to the top surface of some lathe tools provides faster cutting and easier chip removal. Plating improves plastic molds. A paper-making steel roller being hard chrome plated. Briquet-making rollers treated with hard chrome plating. Wear drastically reduced.

Cleaning Aluminium, by J. R. Akers and R. B. Mears. (*Soap and Sanitary Chemicals*, April 1941, B.N.F. Serial, No. 23, p. 711).

The paper gives a concise account of the corrosion behaviour of Al and its alloys ; protection of alloys by cladding ; protection of Al cathodically by Zn strip anodised coatings ; electrochemical corrosion (e.g., by solutions containing Cu salts, from which Cu is deposited) ; blackening of Al utensils ; safe partially safe and harmful cleaners ; notes on recent cleaning problems ; including anodised food trays, and anodised Al external fittings on railway coaches and on buses.

(Communicated by the British Non-Ferrous Metals Research Association).

American Hot-Dip Tinning Practice, IV—Tinning Copper, by W. G. Imhoff. (*Met. Finishing*, April 1941, Vol. 39, No. 4, p. 188).

Outlines the preparation of Cu for hot-dip tinning and the tinning of sheets, tubes, wire and tape by this method. Brief mention only of wiping, electro-deposition and spraying. Short bibliography.

(Communicated by the British Non-Ferrous Metals Research Association).

WELDING, BRAZING, SOLDERING.

Common Errors in Testing Welds, by W. Herscovich. (*The Commonwealth Engineer*, June 2, 1941, Vol. 28, No. 11, p. 325, 9 figs.).

The most marked errors in weld examinations are : (1) Errors in the shape of the test specimens ; (2) errors in the manner of carrying out the test ; and (3) errors in the interpretation of the result. Tensile tests. Ductility of a weld and its measurement. Bend test. Forgeability test.

Repair of Cast Iron Low Pressure Evaporator. (*The Engineer*, July 18, 1941, Vol. CLXXII, No. 4462, p. 38, 7 figs.).

At a power station in the London area, the cast iron body of an evaporator was cracked and broken in service. The British Oxygen Co. Ltd., undertook to make a repair by welding. The repaired evaporator, back in service within two weeks after its removal from the boilerhouse to the welding shop of the

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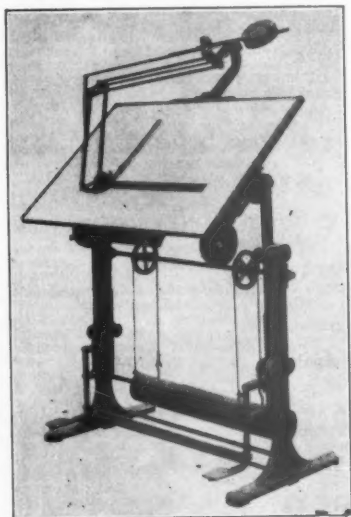
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PRODUCTION ENGINEERING ABSTRACTS

power station is shown. The overall dimensions are about 8 ft. in height and 4 ft. 9 in. in diameter, and the whole weights approximately 4½ tons. The illustrations show: Preheating door with Bunsen flames. Welding crack in door. Welding sequences for door and body. Completed seam after light hammering. The total amount of materials used to complete the job was 65 lb. of "Bronzotectic" ½ in. diameter rod, 475 cubic feet of oxygen, 425 cubic feet of dissolved acetylene, plus the coal gas used for preheating and the electricity for radiator heating. The total number of man hours covering preheating, welding and post-heating and the preparation time amounted to a matter of 140 man hours. The total cost was approximately £40 for labour and supervision and £20 for materials.

The Modern Electrode, by W. Andrews. (*The Welding Industry*, July 1941, Vol. IX, No. 6, p. 142).

To avoid difficulties inherent in weld metal of high hardening capacity, the principle of the use of austenitic weld metal is being employed. A large proportion of the cooling strain in a weld is absorbed in the ductile weld metal and successful joints have been made, even in air hardening steels, by the combination of electrodes of this type and a suitable procedure. Welding of stainless steels. Use of columbium. Welding of copper.

Joining Nickel Alloys. (*Aircraft Production*, July 1941, Vol. III, No. 33, p. 244, 9 figs.).

The soldering and welding of monel, nickel, and inconel sheet. Soft soldering. Silver soldering. Brazing. Welding. Oxy-acetylene welding. Oxygen and flame control. Fluxes. The correct method of welding nickel plate to steel plate. Preparation for welding. A jig for welding short lengths of thin gauge metal. Metallic-arc welding. A jig for welding long lengths of thin gauge material. Electrodes; for monel type 130-X for pure nickel type 131, for inconel type 132, for "K" monel type 134. Welding operation. A photomicrograph showing part of the monel weld and 3/16 in. thick steel plate of a monel-to-steel metallic-arc butt weld. Carbon-arc welding. A jig for welding corners. Spot and seam welding. Flash welding. Relationship between sheet thickness and the current required for welding monel and nickel by the carbon-arc process.

Solders and Soldered Joints. (*Automobile Engineer*, July 1941, Vol. XXXI, No. 412, p. 227).

A description of the various forms of solder is included together with comprehensive information relating to their properties and uses. Considerable attention is devoted to the technique of soldering stainless steels, and also aluminium. Recent developments in silver solders are fully described. Interesting test results on solder brittleness are quoted and considerable information is given in tabular form.

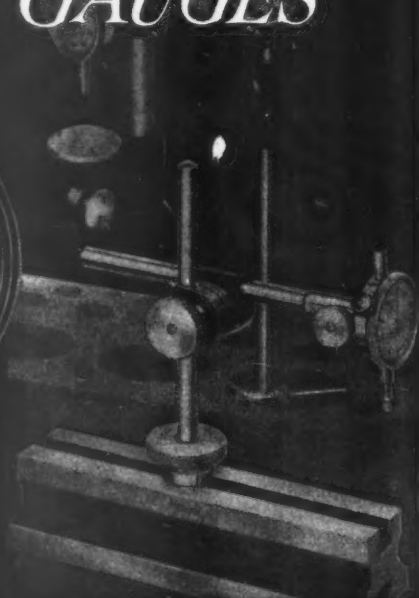
WORKS AND PLANTS.

The Works of Kendall & Gent (1920) Ltd., Gorton, Manchester. (*British Machine Tool Engineering*, May-June, 1941, Vol. XXIII, No. 129, p. 100, 112 figs.).

The works layout in 112 illustrations.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

ANNEALING, HARDENING, TEMPERING.

Surface Hardening by Induction, by Osborn. (*Engineer*, June 6, 1941, p. 372).

It is claimed that phenomenal advances have been made in the application of high frequency current to the localised surface hardening of metals. Among the advantages claimed for the process are absence of distortion and scale formation, exact repetition of conditions, and an inherent increase in quality coupled with a decrease in cost. The questions of carbide diffusion and super hardening are investigated and a brief description is given of the equipment employed in the various operations.

ACCOUNTING, ADMINISTRATION.

Depreciation—Part II, by H. A. Simpson, F.C.W.A. (*The Cost Accountant*, July-August, 1941, Vol. 21, Nos. 2 and 3, p. 165, 5 figs.).

Concluding portion, which consists of a description of a system actually in operation for providing for depreciation in the coal, iron and steel industries.

COMBUSTION, FURNACE.

Furnaces for Re-heating and Heat Treatment of Aluminium and its Alloys, by Aluminium Union, Ltd. (*Aluminium Technique*, No. 14, 1941, p. 12).

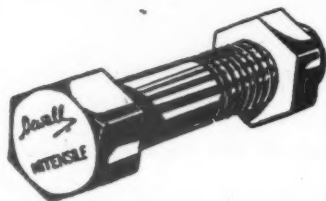
An illustrated account of typical batch-type, forced-air circulation, and salt bath furnaces (heated in various ways).

(Communicated by the British Non-ferrous Metals Research Association).

COOLANT, LUBRICANT.

Lubrication of Ball Bearings—I. (*The Machinist*, August 2, 1941, Vol. 85, No. 19, p. 353).

Chief duties of a ball bearing lubricant are: (1) To provide a tenuous lubricating film between balls and separator pockets, (2) to dissipate heat caused by deformation of load-carrying members and separator, (3) to prevent rust or corrosion of the bearing parts, (4) to aid in protecting the bearing against dirt, water, acid fumes, or foreign matter of any kind. Oils for ball bearings. Grease specifications for ball bearings. Oil viscosities for various temperature ranges.



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ELECTRICITY.

The Electric Strength of Mica and its Variation with Temperature, by W. Hackett and A. Morris Thomas. (*The Journal of the Institution of Electrical Engineers*, August, 1941, Vol. 88, Part I, No. 8, p. 295, 10 figs.).

The electric strength of mica in air, and the intrinsic electric strength and D.C. conductivity of mica, have been measured over extensive ranges of temperature. The effects of thickness and pre-conditioning on electric strength have also been investigated. The experimental conditions necessary for the determination of intrinsic electric strength are considered, and two methods suitable for mica are described. The relevance of the results to industrial applications of mica is discussed.

HYDRAULICS.

Fluid Pressure, by A. P. Young. (*Machine Shop Magazine*, August, 1941, Vol. 2, No. 8, p. 54, 9 figs.).

Pascal's law. The Bramah press. Diagram of hydraulic power transmission system incorporating a constant-delivery pump. Gear pumps. Rotary cylinder pumps. The principle of the rotary cylinder pump. Variable delivery is obtained by adjusting the eccentricity of the rotor. Sliding vane pumps. Diagram of the eccentric rotor and sliding vane pump. Motors. Lapointe horizontal broaching machine operated by power from a variable output pump. Planer drives. Vertical down-pull broaching machine by the American Broach and Machine Co. in which the hydraulic cylinder is movable and constitutes the broaching ram. Planer drive incorporating a floating differential cylinder. Milling machine feeds.

MACHINING, MACHINE TOOLS.

Bore Operations on Medium Caliber Guns. (*The Machinist*, August 16, 1941, Vol. 85, No. 21, p. 390, 15 figs.).

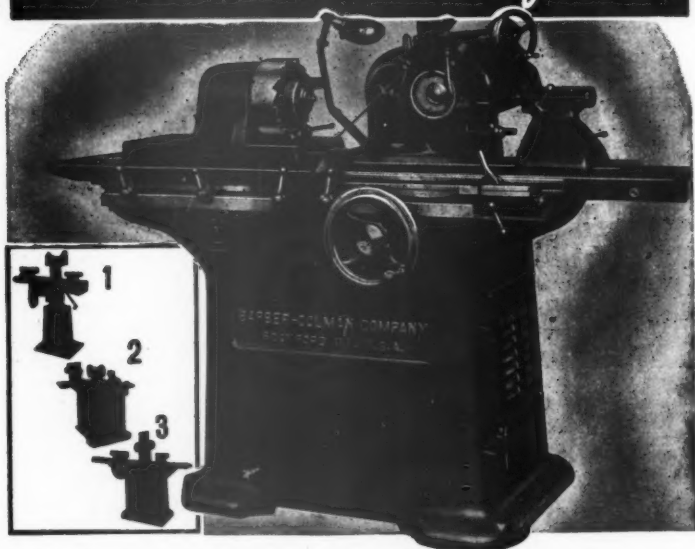
Bore reaming by means of traditional wood-packed tools gives good results but is time consuming. Standard wood-packed reamer bodies for both roughing and finishing are shown for four sizes of gun tubes. Cemented-carbide tools with babbitt or cast-iron pilots have greatly reduced reaming time. The new babbitt-packed reamers use carbide cutters. A set of three gets the 75 mm. tube ready for the honing operation. The 3 in. A.A. gun has a loose replaceable liner that must be taper ground on the outside. Honing is done on surface speeds ranging from 80 to 120 surface feet per minute using a 60:40 mixture of sulphur base oil and kerosene. Bar and set of broaching tools performing the rifling on the 37 mm. gun. Broaching brings economies in rifling. Successive discs are pushed through the bore, each cutting all grooves simultaneously. Honed bores are inspected by the boroscope for quality and the star gauge for size.

CHIPLESS MACHINING.

Press Tools for Small Quantity Manufacture, by G. W. Clarke. (*Machinery*, August 7, 1941, Vol. 58, No. 1504, p. 511, 20 figs.).

It is often advisable to get production started by simple means so that component design and manufacturing difficulties may be smoothed out before proceeding with heavy tool programmes. Twenty samples illustrate the principles of design—standard die sets, the base template, bolster plates, bolster fastenings, blanking dies, fastening dies to bolster plates, punch holders

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PRODUCTION ENGINEERING ABSTRACTS

strippers, laminated stripper plates, piercing tools, forming tools, standard pressure pad, forming tool construction, method of making die sets, pin setting jig, setting the pins in the lower member, setting bushes in the upper member, compound tools, use of brass dies, use of rubber for bending operations.

MANUFACTURING METHODS.

Production of Seamless Tubes by Combined Effects of Cross Rolling and Guide Discs, by W. Trink. (*Transactions of the A.S.M.E.*, June, 1941, Vol. 63, No. 5, p. 411, 7 figs.).

From the various methods of producing seamless tubes the author has selected the Diescher elongator mill as the basis for discussion. For a better understanding of this method of tube production, the most recent Diescher mill installation at Allenport, Pa. is described in some detail. Following this the theory of cross-rolling and guide discs in the process of tube manufacture is explained.

A New Process for Shaping Tubing to any Desired Contour. (*Machinery*, June 12, 1941, p. 287).

Particulars are given of a new process for forming tubing to almost any regular or irregular outline, including straight tapered and rounded portions. The process is stated to be applicable to welded and seamless steel tubes up to 4 in. outside diameter and $\frac{3}{16}$ in. wall thickness in addition to non-ferrous materials. Larger tubing could be handled by a machine of greater capacity or by hot working. Tolerances of plus or minus 0.010 in. with respect both to tube diameter and wall thickness are claimed to be attainable.

The Manufacture of Breech Blocks. (*Machinery*, August 14, 1941, Vol. 58, No. 1505, p. 533, 9 figs.).

The production of a light gun at a Royal Ordnance factory employing female labour.

Machining Operations on Gun Barrels. (*Machinery*, August 7, 1941, Vol. 58, No. 1504, p. 505, 8 figs.).

The production of a light gun at a Royal Ordnance factory in which female labour is employed.

The Lockheed Aircraft Plant, by H. W. Ferry. (*Aircraft Production*, August, 1941, Vol. 3, No. 34, p. 285, 15 figs.).

A survey of production methods at Burbank, cutting and shaping of sheet metal, progressive fabrication. The modern equipment—includes the use of soft metal dies, spot welding, multi-tool routing boards, and rubber dies.

Hydromatic Airscrews. (*Aircraft Production*, August, 1941, Vol. 3, No. 34, p. 273, 25 figs.).

Part I—constructional and operational features of the latest Hamilton type. The manufacture of variable pitch airscrews is a highly specialised branch of the aircraft industry because of the need of extreme accuracy, the employment of high tensile steels, and the intricate shape of many of the components. An outline of the design and main operating features of this airscrew are given together with production data referring to the inner cam, hub casing, and blade segment at the De Havilland works.

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Douglas Method of Flush Riveting Thin Sheets for Aircraft. (*Aut. Ind., U.S.A., Vol. 84, No. 10, May 15, 1941, p. 518*).

The rivet has a cylindrical shank 3.1 mm. diameter with a conical head of 100° taper and 5.50 mm. maximum diameter. A very shallow cylindrical crown (depth .15 mm.) is provided on the head, and this is stated to ensure a tighter fit during the subsequent closing process. The original volume of the head is 18.6 cu. mm., and the ratio of the original diameter to the original height is 4.78. In setting the rivet, it is first inserted into the hole in the sheets with the shank extending into a tubular "bucking tool" the upper end of which is countersunk at 110.8°. One or two blows of the hammer (impact of the order of 11 ft. lb. suffice to dimple the sheets and seat the rivet. During this operation, the head diameter is increased to six mm. and the height reduced from 1.15 to one mm. The volume of the new head is now 16.9 cu. mm., and the diameter/height ratio is increased to 6.0. The final step consists in upsetting the shank of the rivet by a series of blows of a riveting hammer fitting snugly inside the cylindrical portion of the bucking tool. During this operation the dimpling hammer rests on top of the rivet head and acts as a countermass.

(Communicated by the D.S.R., Ministry of Aircraft Production).

MATERIALS, MATERIAL TESTING.

The Production and Physical Characteristics of Magnesium Alloys, by F. A. Fox. (*Met. Ind., June 27, 1941, Vol. 58, No. 26, p. 547, July 4, 1941, Vol. 59, No. 1, p. 2*).

Extraction of Mg by electrolytic and thermal methods, grain refinement by superheating, compositions of cast and wrought Elektron alloys, extrusion and rolling, mechanical properties, heat treatment, microstructure.

(Communicated by the British Non-ferrous Metals Research Association).

Current Position of Light Alloys in Marine Engineering Practice, (*Light Metals, June, 1941, Vol. 4, No. 41, p. 120*).

Deals mainly with American practice, together with a brief note on British developments.

Materials for Electrical Contacts, by J. C. Chaston. (*The Journal of the Institution of Electrical Engineers, August, 1941, Vol. 88, Part II, No. 4, p. 276, 10 figs.*).

The principal types of failure in light and medium-duty electrical contacts are analysed in detail and an account is given of the characteristics of the commonly used contact materials. The effects on contact resistance of the size, shape, surface finish, and closing pressure of light-duty contacts are discussed. An account is given of the resistance of contact materials to the formation of tarnish films, and attention is directed to the effects of dust and grease films in causing failure.

Surface Cracks of Clad Al-Cu-Mg. Alloys Undergoing Reversed Bending, by H. Burnheim and R. Mechal. (*Z. f. Metallkunde, Germany, Vol. 33, No. 1, January, 1941, p. 25*).

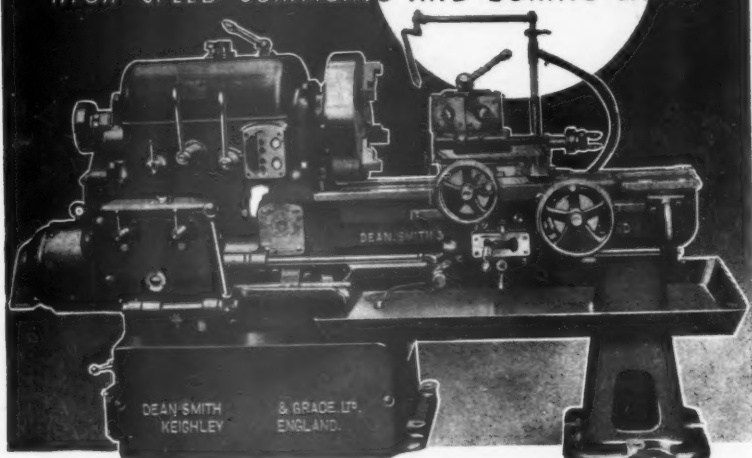
Samples of high grade clad Al-Cu-Mg sheets undergoing reversed bending showed a considerable roughening of the surface due to formation of surface cracks in the protecting layer long before the ultimate failure of the core. These cracks are due to differences in the yield point and fatigue limits of protecting surface sheet and core. If the reversed bending stress is of the

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order of the yield point of the core (i.e. failure after a few thousand cycles) surface roughening becomes apparent almost immediately. For lower bending stresses corresponding to an endurance of 107 cycles, the surface cracks take longer to develop and are fewer in number. On the other hand such cracks are now much deeper, some of them projecting right into the core. It is clear that deep cracks may effect the fatigue strength of the core material (notch sensitivity). In any case the corrosion resistance of the combination must be reduced by their presence.

(Communicated by the D.S.R., Ministry of Aircraft Production).

MEASURING METHODS.

Tolerance for Aircraft Parts, by H. G. Conway. (*Aircraft Production*, August, 1941, Vol. 3, No. 34, p. 281, 3 figs.).

Some notes on existing practice and a proposed system of modified tolerances. Production engineers will be interested in the proposed system of modified B.S.I. unilateral standards on the lines of the I.S.A. metric system of tolerances.

An Inside Look at Welds, by Baldwin. (*Machinist*, June 7, 1941, p. 149).

Particulars are given of the technique employed by the General Electric Co., of Schenectady for the examination of welds by X-rays. The use of stereoscopic location of flaws is explained and details given of the procedure and apparatus employed. A special technique has been developed for the G.E. welding school where test plates are X-rayed in groups to keep cost at a minimum.

MECHANICS, MATHEMATICS.

Helical Compression Springs, by J. W. Lee. (*The Tool Engineer*, July, 1941, Vol. X, No. 7, p. 45).

A simple solution to the ordinary spring problem and a spring data sheet that will save much needless design work. The carrying capacity is directly proportional to the square of the wire diameter. The stress and deflection are both directly proportional to the load carried by the spring. Sample calculations. Final calculations.

SMALL TOOLS.

A New Diamond Drill Bit, by D. A. P. Wilson. (*The Industrial Diamond Review*, August, 1941, No. 9, p. 57).

Investigation to find industrial uses for boart and other inferior diamonds, more especially the finer grains and dust, produced in large quantities in South Africa. Possibility of using these finer grains in rotary rock drills. Effect of loading diamond crowns above and below the critical value. Classification of rocks with reference to boart impregnated drills.

How to Use Dressing Tools. (*Industrial Diamond Review*, August, 1941, No. 9, p. 54, 4 figs.).

Wheels for precision grinding must be balanced or re-balanced after truing. The dressing should not be performed outside the working range, as the surface is then influenced by inaccuracies of the machine. Illustrations show special methods for truing stepped wheel faces by means of diamond tools.

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STANDARDISATION.

British Standard Specifications for Lead-Bronze Castings and Ingots, by British Standards Institution. (*B.S. Spec. 960-965, May, 1941, p. 21, B.N.F. Serial 23, 674*).

Nos. 960 and 961 for Cu-Sn-Zn-Pb 85/10/05 castings and ingots, Nos. 962 and 963 for 80/10/0/10, Nos. 964 and 965 for 76/9/0/15. Composition and tensile properties. These alloys will be designated "85/10/0/5 lead-bronze," etc., the absence of Zn being indicated to differentiate them from gun-metal alloys of the type covered by B.S. 898-901.

(Communicated by the British Non-ferrous Metals Research Association).

SURFACE TREATMENT.

Effect of Surface Finish, by J. T. Burwell and others. (*J. App. Mech., U.S.A., Vol. 8, No. 2, June, 1941, p. 49*).

Surface finishes produced in various ways having roughnesses ranging from 130 to one micro-inch (as measured by their root-mean-square deviations from a median plane), have little or no effect on the performance of a partial journal bearing while it is operating under hydrodynamic lubrication. There is general agreement with theory in this region, but the agreement is improved if account is taken of the breaking of the film near the outlet end of the bearing. The lower limit of the region of hydrodynamic lubrication for a given journal bearing combination as indicated by the minimum in the friction-coefficient curve is markedly dependent on the surface finish of the journal. The load capacity of the bearing increases with increasing smoothness, and this emphasizes the great importance of reducing the surface roughness to less than 15 micro-inches at least. A sensitive method of determining iron in oil has been developed, involving the extraction of the iron from the oil by means of hydrochloric acid. This permits the determination of one part of iron in 10,000,000 parts of oil. This method was applied to the study of the wear-in of a journal-bearing combination. The effect of pressure on the running-in process was studied while maintaining a constant surface finish. The results indicate that the wear at the end of two hours increases with pressure for the pressure range up to 1,000 psi and the conditions obtaining in these studies. The effect of surface finish on the running-in process was measured at constant pressure. A remarkable straight-line relationship exists between the total wear at the end of two hours and the degree of surface finish, at the constant pressure employed. It was found that the running-in period takes place in a short time (of the order of one-half to one hour). The initial rate of wear is high and falls off fairly rapidly. In all cases the quantity of metal removed was quite small, being less than a millionth of an inch if it could be considered as being removed uniformly.

(Communicated by the D.S.R., Ministry of Aircraft Production).

TECHNICAL INFORMATION.

Progress and Prospect in Aircraft Production, by J. H. Jouett. (*Aut. Ind., U.S.A., Vol. 84, No. 10, May 15, 1941, p. 515*).

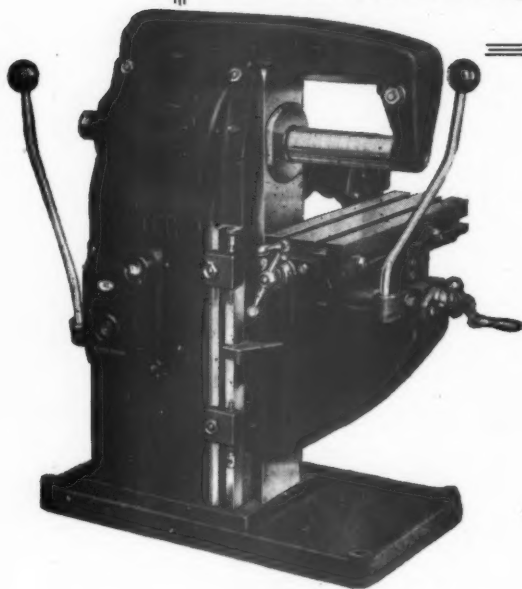
Aircraft manufacturers to date have been asked to build about 44,000 military aircraft, roughly distributed as follows—

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- 8,500 U.S.A. navy.
- 16,000 Great Britain and Canada.
- 3,600 bombers (Knudsen plan).

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The bulk of these orders have been placed since the autumn of 1940 and 7,000 'planes have so far been delivered. Since the outbreak of the war 3,500 military aircraft have been supplied to Great Britain. The following production figures are quoted—

November	...	...	1940	700 'planes	
December	...	...	1940	800	"
January	...	...	1941	1,000	"
March	...	...	1941	1,200	"
Summer	...	...	1942	2,400	" (estimated).
Estimated output	1941	...	...	18,000	"
"	"	1942	...	30,000	"

It is stated that a medium bomber consists of 30,000 parts exclusive of bolts, nuts, and rivets. These parts are worked into 650 sub-assemblies and these in turn into 32 major sub-assemblies before the aircraft is finally assembled. The total labour involved amounts to 30,000 man hours per machine. The author concludes that even now half the U.S.A. output coupled with the British output exceeds the Axis production.

(Communicated by the D.S.R., Ministry of Aircraft Production).

A Tight Situation in Zinc, by E. E. Thum. (*Metal Progress*, May, 1941, Vol. 39, No. 5, p. 557).

An examination of U.S. requirements in Zn (estimated at 935,000 tons in 1941, including export) and methods of meeting it including ore supply.

(Communicated by the British Non-ferrous Metals Research Association).

WELDING, BRAZING, SOLDERING.

Pressure Pipe Welding, by A. Scott. (*Institute of Welding Transactions*, July, 1941, Vol. 4, No. 3, p. 141, 50 figs.).

The report records the experiences in the welding of joints in pressure pipe lines and the results of numerous investigations on the Dawson type joint. The sleeve welded joint. The Dawson joint. Butt welds. High temperature and high pressure steam test on Dawson joint without flanges.

The Function of Contact Resistance in Spot Welding, by R. F. Tylecote. (*Institute of Welding Transactions*, July, 1941, Vol. 4, No. 3, p. 154, 20 figs.).

On the nature of contact resistance. Types of contact. Contact resistance in spot welding. The effect of pressure. The effect of surface condition. The effect of temperature. Change of resistance during the welding cycle.

Oxy-acetylene Machine Cutting of Selected Types of High Tensile Structural Steels, by L. C. Percival. (*The Institute of Welding, Quarterly Transactions* July, 1941, Vol. 4, No. 3, p. 114, 29 figs.).

Eleven steels, $\frac{1}{2}$ in. and 1 in. thickness, the chemical analyses of which are given in Table I, have been oxy-acetylene machine cut under controlled conditions. Tensile test results on oxygen cut specimens are compared with results obtained on specimens prepared by machine tools. Cold bend test results on oxygen cut specimens are also given. Hardness test results on taper ground oxygen cut specimens are recorded, and the results of microscopical examinations carried out to determine alterations in structure resulting from the oxygen-cutting are stated. The oxy-acetylene cutting was carried out with a 20 in. Universal cutting machine. The normal gas pressures and nozzle sizes for each thickness of plate were used. Rotameters were inserted in the

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PRODUCTION ENGINEERING ABSTRACTS

lines supplying the gases in order that after ascertaining the correct heating flame, identical adjustment could be made for every subsequent cut. The data sheets (Tables X and XI in the appendix) give the oxygen pressures, nozzle sizes, and the best cutting speeds in feet per hour for each individual plate.

The Fabrication of Machine Frames by the Electric Arc, by T. O. Ogden. (*The Australasian Engineer*, June 7, 1941, Vol. 41, No. 301, p. 18, 5 figs.).

The general principles are discussed and the following examples shown. (1) All-steel heavy duty guillotine shears (there is little doubt that this gigantic machine would never have been built had rolled steel not been used as a constructional material), (2) all-steel medium duty guillotine (capacity 10 ft. by $\frac{1}{2}$ in. mild steel), (3) all-steel fabricated gear blank (this wheel is lighter and yet stronger than a cast steel wheel and can be produced faster and more cheaply), (4) all-steel leather finishing press of 500 tons capacity, (5) all-steel fabricated reduction gear housing. The gear reduction unit transmits 1,500 h.p. The cast steel housings are welded directly into the mild steel fabricated frame.

WELFARE, SAFETY, ACCIDENTS.

Workmen's Compensation as it Concerns the Work's Doctor, by H. Samuels. (*Industrial Welfare and Personnel Management*, August, 1941, Vol. XXIII, No. 273, p. 173).

Notice of accident and failure to claim. Incapacity. Medical examinations. Actions at common law. Negligence in treatment. Workers' obligations.

Throwing Light on Sabotage, by Dean M. Warren. (*The Machinist*, August 9, 1941, Vol. 85, No. 20, p. 375, 5 figs.).

One of industry's major problems is to protect its plants against saboteurs. Lighting is the basic aid now being used. Three protective agents—lighting fencing, and guards—are in use. When floodlighting projectors are placed concealed areas are less inviting to saboteurs.

A Motor-operated "Black-out" Installation. (*Mechanical World*, August 15, 1941, Vol. CX, No. 2850, p. 105, 6 figs.).

Immediate operation by push-button from one control centre. Illustration shows method of fixing movable shutter over north lights. Winch driven by $\frac{1}{4}$ h.p. D.C. motor with limit switches.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

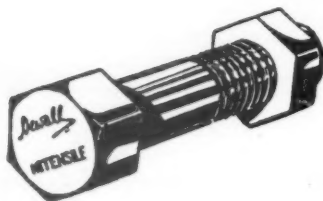
NOTE.—The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

ANNEALING, CASEHARDENING, TEMPERING.

Surface Hardening by Induction. (*Mechanical Engineer, U.S.A., Vol. 63, No. 8, August, 1941, p. 602.*)

The heating is accomplished by the use of high-frequency currents. Specifically chosen frequencies from 2,000 to 10,000 cycles are being used extensively at the present time. Current of this nature, when caused to flow through an inductor, will produce a high-frequency magnetic field within the region of the inductor. When a magnetic material such as steel is placed within this field, there is a dissipation of energy in the steel both due to hysteresis and eddy currents. Due to the well known skin effect, the heating is limited to the outside layers. When the temperature of an inductively heated steel bar arrives at the critical value all heating due to hysteresis ceases, and that due to eddy currents continues at a greatly reduced rate. Since the entire action goes on in the surface layers, only that portion is affected. The original core properties are maintained and the surface hardening is accomplished by quenching when complete carbide solution has been attained in the surface areas. Continued application of power causes an increase in depth of hardening, for as each layer of steel is brought to temperature the current density shifts to the layer beneath, which offers a lower resistance. It will at once be obvious that the selection of the proper frequency and control of power and heating time will make possible the fulfilment of any desired specifications of surface hardening. Induction hardening produces a hardness which is maintained through 80% of its depth and from there on toward the core, a gradual decrease through a transition zone to the original hardness of the steel as found in the core which has not been affected. The bond is thus ideal, eliminating any chance of spalling or checking. In addition to the selective surface hardening of steels, there have been other applications of induction heating of rather a unique nature. Hardening a piece of steel and brazing to copper and other metals may be done simultaneously. A small section of a previously hardened object can be drawn or softened to a condition possessing ready machinability. Heating for forging and upsetting has been found to be a particularly satisfactory use for induction heating. The speed with which this may be accomplished has made it readily adaptable to the high production requirements of forming equipment, and scale problems are reduced to a minimum. The corresponding increase in die life is of extreme importance. Tip annealing of brass cartridge shells at the rate of 100,000 per hr. is provided with a single induction-heating unit.

(Communicated by D.S.R., Ministry of Aircraft Production.)



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POSSILPARK **GLASGOW, N**

ACCOUNTING, ADMINISTRATION.

Research Work on Production Costs, by J. A. MacMillan. (*The Cost Accountant*, September, 1941, Vol. 21, No. 4, p. 184).

Industrial concerns have engaged increasingly in research and the results include improvements in design, reduced cost of production, new lines of merchandise, and new markets for old lines. The cost of innovations. Closer co-operation between workshop and cost department. A useful object of research should be to discover the best method of keeping alive the interest of executives and workers in production costs. An effective cost system should be capable of the following activities: (1) Ensuring accuracy in the cost of specified articles; (2) Using the costs to indicate production efficiency; (3) Devising methods of speeding up cost data; (4) Compiling reports for executives; (5) Determining standard production costs. Research technique. (a) The statement of the problem which forms the specific object of the inquiry; (b) Assembling the available information; (c) Analysing the information to get at essential facts; (d) Formulating a possible solution and testing it by experiment; (e) Embodying the results in a report for ready reference.

COMBUSTION, FURNACE.

Effect of Furnace Atmospheres in Non-Ferrous Melting (Copper Alloys), by J. M. Kelly. (*Amer. Found. Assoc. Preprint 41-20*, May, 1941, p. 7, B.N.F. Serial 23,827).

A general discussion of present knowledge.

(Communicated by the British Non-Ferrous Metals Research Association).

COOLANT, LUBRICANT, FUEL.

The Behaviour of Lubricating Oils at Low Temperatures, by K. Siebald. (*Luftwissen, Germany*, Vol. 8, No. 7, July, 1941, p. 224).

Investigation on the low temperature properties of complex mixture such as lubricating oils concern mainly their resistance to flow, both as regards the initiation of motion and the maintenance of the subsequent flow.

The low temperature starting resistance can be estimated in a special apparatus developed by the I.G. Farben which records the force required to move a piston previously stuck by the cold oil crystallite. Viscosity determination at low temperature (i.e., actual flow carried out by the usual methods are rendered inconsistent by the phenomena of plasticity exhibited by oils under these conditions. These difficulties have been overcome by the D.V.L. by carrying out the viscosity determination under pressure of the same order as occur in the engine circuit.

Under these high pressures, the oil crystals are broken up and consistent pseudo laminar flow is obtained. It is stated that by the use of the I.G. and D.V.L. instruments an accurate laboratory rating of the oils as regards their low temperature behaviour in an engine has been made possible for the first time.

(Communicated by D.S.R., Ministry of Aircraft Production.)

Lecithin as Stabiliser for Leaded Fuels. (*Autom. Ind., U.S.A.*, Vol. 85, No. 4, September 15, 1941, p. 25).

Lecithin produced from Soyabeans is said to have proved of value as a stabiliser for petrol, and specially leaded petrol. When leaded petrol is exposed to sunlight, it may become cloudy, colour changes may take place, and the fuel tank may be subjected to corrosion in the presence of moisture.

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B267

PRODUCTION ENGINEERING ABSTRACTS

In one particular case the addition of 10 lb. of soyabean lecithin to 1000 barrels of aviation petrol is said to have prevented the formation of precipitates. The corrosion-inhibiting properties of lecithin are especially valuable in the case of aircraft, which usually have fuel tanks made of sheet aluminium.

(Communicated by D.S.R., Ministry of Aircraft Production).

Engine Bearing Temperatures. (*Mechanical World*, September 26, 1941, Vol. CX., No. 2856, p. 207, 1 fig.).

Effects of clearance, oil flow, jacket temperature and oil viscosity.

MACHINE ELEMENTS.

Instrument Bearings. (*Mechanical Engineer*, U.S.A., Vol. 63, No. 8, August, 1941, p. 601).

Diamonds, rubies, sapphires, synthetic sapphires, garnets, chrysoberyl spinels, zircons, topazes, rock crystal and agates, are made into watch and chronometer jewels and bearings for meters and other scientific instruments.

The diamond, although superior to other gems, is not widely used, due to the cost of the rough stone and the time and labour expended in shaping this the hardest of all substances.

Sapphire and ruby jewels (mostly synthetic) serve as pivots and counter pivots used in electrometers. Such jewels are not pierced but are cut into "cup jewels." Jewelled bearings are also used for bomb fuses and in the instruments for combat airplanes and bombers. A modern Curtiss pursuit plane has at least 90 instruments, dials, knobs, etc., and many of these require jewel bearings. Navigation watches alone have 21-jewel movements.

(Communicated by D.S.R., Ministry of Aircraft Production.)

Spark Plug Threads in Light Metals. (*Automotive Industries*, U.S.A., Vol. 85, No. 3, August 1, 1941, p. 48).

When a spark plug has to be secured into the wall of a cylinder or cylinder head cast of a light alloy, it is customary to insert a bushing of some stronger material. To obviate the need for such a bushing, a German firm has patented a special thread for spark plugs and spark-plug holes. Both the spark plug and the hole for it are cut with a relatively coarse V thread, the thread in light metal has the top half removed, and the thread on the plug groove is filled up with metal to half its depth. Only the top half of a normal V thread is used on the plug and the bottom half in the light metal part. For a given radial depth of thread this gives a much stronger thread in the light metal part.

(Communicated by D.S.R., Ministry of Aircraft Production.)

Types of Anti-Friction Bearings and Their Uses—Parts V and VI. (*Power Transmission*, August, 1941, Vol. 10, No. 115, p. 294, 8 figs.; September, 1941, Vol. 10, No. 116, p. 339, 6 figs.).

Part V. Combined journal and thrust (angular contact) bearings.

Part VI. Ball thrust bearings. Essential features of bearing selection. Journal loads. Combined journal and thrust loads.

White Metal Stuffing Box Rings, by H. Warburton. (*Mechanical World*, September 12, 1941, Vol. CX, No. 2854, p. 173, 20 figs.).

Double cone packing. Diamond and grooved-ring packing. Spring ring packing. V-packing and lantern ring.

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MACHINING, MACHINE TOOLS.

The Reconditioning of War-damaged Machine Tools. (*Machinery*, September 18, 1941, Vol. 58, No. 1510, p. 673, 17 figs.).

Methods employed by leader firms in the Ministry of Supply reconditioning scheme.

The Herbert patent Carbicut Lathe. (*Machine Tool Review*, June, July, August, 1941, Vol. 29, No. 178, p. 40, 7 figs.).

The Herbert patent Carbicut lathe for high-speed machining of shafts from $\frac{3}{4}$ in. to 2 $\frac{1}{2}$ in. diameter up to 22 in. long. Recommended speeds for various steels. Arrangement of tools. End view of Carbicut lathe showing stop bar and motor driven quick power traverse. Cross slide showing stop bar and chip-breaker. The work carrier accommodates all sizes of shafts within the capacity of the machine. Examples of work produced on the Carbicut lathe. Number of spindle speeds—16; Range of slow speeds—445 to 1990 r.p.m.; Range of high speeds—676 to 3025 r.p.m.; Automatic feeds to the saddle—70, 105, 140 cuts per inch.

Precision Boring—Plus, by G. D. Stewart. (*The Machinist*, September 20, 1941, Vol. 85, No. 26, p. 537, 7 figs.).

Precision boring machines will perform a number of operations in addition to boring. Typical set-ups demonstrate the ways in which the work and tools may be arranged for a variety of operations, singly or in combination.

A Cutter Radius Grinding Fixture. (*Machinery*, August 21, 1941, Vol. 58, No. 1506, p. 583, 1 fig.).

To grind the radius on a side and face milling cutter is practically impossible without a fixture of some description. The fixture described is applicable to cutters from 3 inches to 10 inches diameter and of any width up to 2 $\frac{1}{2}$ inches.

CHIPLESS MACHINING.

New Billet Cutter for Shearing up to 4 $\frac{1}{2}$ in. sq. Cold. (*Industrial Power and Fuel Economist*, August, 1941, Vol. XVI, No. 191, p. 110, 3 figs.).

General design of the hydraulic machine. Two-part bed. Mounting of slide. The drive is from an 85 h.p. motor to the high-speed shaft through 8-strand vee ropes. Two heavy balanced flywheels of cast-steel are fitted, and the flywheel shaft is mounted in heavy roller bearings. A separate motor and pump, mounted near the base of the machine, provides forced feed lubrication to all main bearings.

Roll Forming of Metal Sections from Strip, by E. Barron. (*Machinery*, September 25, 1941, Vol. 58, No. 1511, p. 710, 8 figs.).

Features of roll design are indicated and the production of a typical stringer section, using a 7-stage mill is described in detail.

The Use of Rubber in Conjunction with Press Tools, by F. L. Joye. (*Machinery*, September 11, 1941, Vol. 58, No. 1509, p. 645, 31 figs.).

When using rubber in conjunction with press-tools, advantage is taken of a property which it possesses in common with fluids, namely, its ability to flow. This fluid quality is augmented in the case of rubber by the additional property of cohesion, a factor which plays a vital part in the working of materials with the aid of rubber and dies. A considerable saving in toolmaking is achieved in connection with bending and like operations, and still greater saving where cutting and stamping is performed, especially in the case of irregular contours. Examples of the behaviour of rubber in bending, shearing, and piercing operations are given.



F
IELDING
HYDRAULIC
PRESSES
& PUMPS



FIELDING & PLATT LTD., GLOUCESTER.

Pneumatic Tools, Part IV. (*Aircraft Production, September, 1941, Vol. III No. 35, p. 323, 17 figs.*).

Description of air-operated and hydro-pneumatic squeeze riveters including a special type of yoke with a hinged jaw, for use on works which cannot be passed through a fixed yoke. Also general notes on riveting practice with illustrations of the results of employing the squeeze riveting process on rivets not supported for their full length of metal, and examples of faulty riveting due to the use of incorrectly shaped snaps.

MANUFACTURING METHODS.

Line Production of 3-in. A.A. Shell. (*The Machinist, September 20, 1941, Vol. 85, No. 26, p. 541, 18 figs.*).

Methods used by the S.A. Woods Machine Company in production of the 3-in. high explosive anti-aircraft shell.

Reproduction of Work Templates by the Electrolytic Press. (*Aviation, Vol. 40, No. 4, April, 1941, p. 113*).

Said to be faster and more economical than the photo-loft-template process, the new method is simple and the materials used are standard in most plants. A master layout is scribed from an engineers' drawing on a galvanised iron sheet about .040 in. thick, one face of which has been prepared by a special coating of insulating paint. Layout thus formed is sprayed with a transfer solution and the wetted surface is pressed into firm and uniform contact with a copyplate in a specially built press. An electric current passing between the two plates results in the layout of the master plate being transferred instantly to the copy plate. Given a thin protective coating, the copy plate is then ready for immediate use by the template cutters. Total time required from the moment the copy plate is placed in the press with the master plate until it is washed, dried and ready for the template department is not more than 5 min.

(Communicated by the D.S.R., Ministry of Aircraft Production.)

Machining Operations on Airplane Parts. (*Machinery, September 18, 1941, Vol. 58, No. 1510, p. 683, 14 figs.*).

Methods employed at the plant of North American Aviation, Inc.

Production Operations on Lockheed Interceptors and Hudson Bombers. (*Machinery, September 25, 1941, Vol. 58, No. 1511, p. 701, 11 figs.*).

Methods employed by the Lockheed Aircraft Corporation.

Hydromatic Airscrews, Part II. (*Aircraft Production, September, 1941, Vol. III, No. 35, p. 311, 35 figs.*).

Methods employed by the de Havilland Aircraft Co., Ltd., Machining the hub spider. Automatic turret lathe feed and speed data. Blade production, including taper drilling, contour milling, grinding and balancing.

Power for Army Trainers. (*The Machinist, September 6, 1941, Vol. 85, No. 24, p. 488, 36 figs.*).

Methods used by Ranger Aircraft Engines, Division of Fairchild Engine and Airplane Corporation, in building six-cylinder in-line direct-drive engines for training planes used by the Army Air Corps.

Power Line Assembly of Aircraft. (*Aircraft Production, September, 1941, Vol. III, No. 35, p. 308, 7 figs.*).

Assembly lines and layout of plant at Vultee factory. A diagram illustrating the factory layout at one of the Vultee plants is given and descriptions of fabricating and sub-assembly, conveyor design and engine assembly are included.

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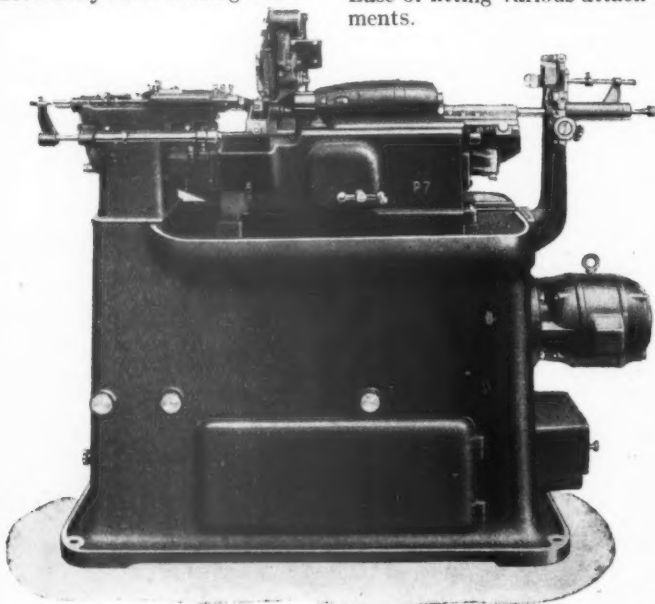
Sliding Headstock—rigid setting of the five toolholders.

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Finishing Magnesium Die-Castings, by H. W. Schmidt. (*Amer. Soc. Test. Mat. Preprint 18, June, 1941, p. 15, B.N.F. Serial 23,858*).

Mechanical finishing (buffing, etc.) ; cleaning ; chemical treatment (chrome-pickle, hydrofluoric-dichromate, chrome-alum, etc.) ; painting.

(Communicated by the British Non-Ferrous Metals Research Association).

MATERIALS, MATERIAL TESTING.

Persistent Austenite, by H. E. Arblaster. (*The Australasian Engineer, July 7, 1941, Vol. 41, No. 302, p. 16a, 13 figs.*).

The effect of alloying elements on the ranges of stability, persistence and decomposition of Austenite. The constitution of water-cooled iron-manganese carbon alloys. The actual form of the diagram showing the effect of carbon and nickel on constitution. The composition limits for pure Austenite at 2,100°F. (1150°C.) for a variety of elements. The effect of several uniform Titanium contents upon the carbon limitations for pure Austenite at elevated temperatures. The effect of several uniform chromium contents upon the carbon limitations for pure Austenite at elevated temperatures. Sections through the Fe-Cr-C Model at various chromium contents, showing trend of structural changes. The iron corner of the iron-manganese-carbon diagram showing the results obtained under ordinary conditions of cooling. The effect of nickel and chromium on retention Austenite.

Materials for Electrical Contacts. (J. C. Chastton, *J. Inst. of Elect. Eng., Vol. 88, Part II, No. 4, Aug., 1941, p. 216.*)

The principal types of failure in light- and medium-duty electrical contacts are analysed in detail and an account is given of the characteristics of the commonly used contact materials.

The effects on contact resistance of the size, shape, surface finish and closing pressure of light-duty contacts are discussed ; an account is given of the resistance of contact materials to the formation of tarnish films ; and attention is directed to the effects of dust and grease films in causing failure.

In medium-duty contacts, when arcing occurs, the most serious cause of failure is the action known as "material transfer" which takes place when direct currents are interrupted. As a result of transfer the contact gap may close and the contacts finally interlock. The factors which influence material transfer are discussed, and curves are reproduced to show the limiting current and the rate of build-up for a number of common contact materials under given test conditions.

A second cause of failure is the welding-together of the contacts by the current surge at make. The inherent tendency of a number of contact materials to weld together has been measured.

In sliding contacts, excessive wear is a frequent cause of troubles. A method of testing the wear of unlubricated surfaces is described, and the results of measurements on a number of combinations are tabulated.

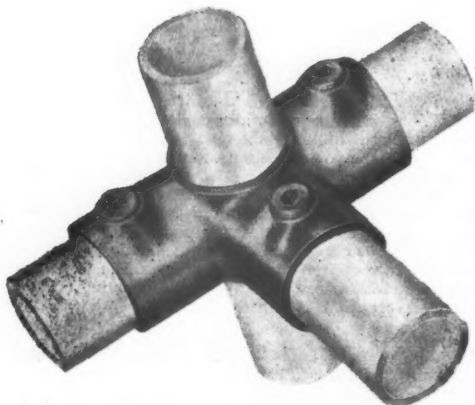
(Communicated by D.S.R., Ministry of Aircraft Production.)

Magnesium, by A. W. Winston. (*Amer. Soc. Metals, Western Metals Congress Paper (Typescript), May, 1941, p. 31, B.N.F. Serial 23,881*).

Useful up-to-date notes on properties ; action of chemicals ; alloys ; sand, permanent-mould and die-casting ; forgings ; structural shapes ; sheet ; machine shop practice ; fabrication ; surface protection ; design.

(Communicated by the British Non-Ferrous Metals Research Association)

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PRODUCTION ENGINEERING ABSTRACTS

Strengthening Aluminium for Aircraft Structures, by K. R. Jackman. (*Metal Progress*, Vol. 40, No. 1, July, 1941, pp. 35/42, 88).

A typical modern 4 engined aircraft weighing 50,000 lbs. gross will have a tare weight of about 27,000 lbs. of which 11,000 lbs. represent engines, propeller, accessories, and non-structural furnishing. The remaining 16,000 lbs. of structure will be subdivided roughly as follows :

Metal	Form	Wing	Fuselage	Tail	Landing gear	Controls and Misc.	Total
Steel	Cr—Mo	300	200	20	1000	80	1600
	Stainless	500	50	—	—	50	600
Magnesium.	Castings	—	—	—	—	50	50
	Sheet	7000	2100	800	100	500	10500
	Extrusion	150	100	50	25	175	500
Al.	Drawn Parts	950	400	100	—	50	1500
Alloy	Castings	—	—	—	—	100	100
	Forgings	150	50	25	100	25	350
	Rivets	250	100	50	—	50	450
Others	all	20	20	20	40	100	200
Grand Total lbs.							15850

Aluminium alloys thus account for 13,400 lbs. out of the total of 15,850 lbs. The sheet metal covering wings, fuselage and tail represent the biggest item, i.e., 10,500 lbs. The present trend is to use 24 stalclad sheet which eliminates most of the corrosion troubles, and very little can be done to strengthen this product still further so as to save weight.

It has been known, however, for some time that extrusions and drawn shapes can be considerably strengthened by cold working and although the total weight of products of this type in the aircraft under consideration amount to only 2,000 lbs., this treatment would be worth while provided practical shop procedures can be developed. The author describes the method adopted by Consolidated Aircraft for prestretching structured sections to 3½ % permanent set on the straightening jib at very little extra cost. The gain in ultimate and yield strength of the material is such that a saving in weight of about 10 % results. The reason for limiting the prestretching to 3½ % permanent set is mainly the need for retaining sufficient residual elongation to accommodate stress concentrations and dynamic load. Greater prestretching also increases the amount of rejected material.

MEASURING METHODS.

How Thick a Plate : by Raymond F. Yates. (*The Machinist*, September 6, 1941, Vol. 85, No. 24, p. 477, 4 figs.).

Various methods of measuring the thickness of chromium plating are given.

Machine Tool Alignment Tests, by G. Schlesinger. (*Machinery*, September 4, 1941, Vol. 58, No. 1508, p. 630, 1 fig.).

This letter includes test sheets supplied by Gisholt Machine Co. with new Capstan lathes giving permissible and actual tolerances.

Problem of Weight Control, by L. R. Hackney. (*Aero Digest*, U.S.A., Vol. 31, No. 1, July, 1941, p. 134, 237).

The Society of American Weight Engineers was organized about 2 years ago with the object of a closer relationship between weight engineers and to correlate weight information. With the cooperation of every major aircraft

2 OF THE STANDARD TYPES OF Dawson METAL PARTS WASHERS



There are five standard types of Dawson M.P.W. machines; three for washing only (Minor, Junior and Size A); one for washing and rinsing (Size B) and one for washing rinsing and drying (Size C). *The Minor* is the smallest in the range and is a handy little machine for either the small works or for departments in larger organisations.

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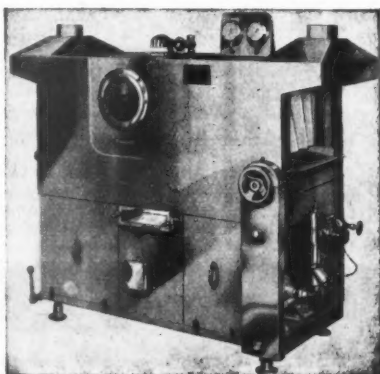
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PRODUCTION ENGINEERING ABSTRACTS

firm, a Master Weight book has been compiled and the Army and Navy Standard Detail and Group Statements have been revised. The aircraft structure is subdivided into 7 main groups. The lay out for the estimated weights of the wing group and one of its principal subdivisions is illustrated below, the figures applying to a 4 engine transport of 40,000 lbs. gross weight.

	Weight	Arm	Horizontal Moment
Wing Group :	3964.0	453.5	1798055
Inner Wing Panel	2905.0	450.4	1308602
Outer Wing Panel	642.0	435.4	
Tips	25.0	428.0	
Ailerons	109.0	474.0	etc.
Flaps	283.0	521.0	
Inner Wing Panel :	2905.0	450.4	1308602
Front Beam	286.0	416.0	
Intermediate Lean	—	—	
Rear beam	248.0	479.0	
Auxiliary beam	—	—	
Ribs	536.0	449.0	etc.
Stringers	—	—	
Fittings	108.0	448.3	
Corrugations	369.0	449.8	
Gussets	—	—	
Formers	—	—	
Channels	—	—	
Stiffeners	115.0	453.5	
Angles	—	—	
Fillers	39.0	449.8	
Fabric	—	—	
Metal Covering	668.0	461.0	
Paint	32.0	449.0	
Inspection doors	13.0	474.0	
Fairing	18.0	434.0	
Leading Edge	123.0	406.0	
Hinge and Pins	—	—	

Weight control may be divided into :

- (1) Parts entirely within the Design groups control, (Wing, fuselage, tail, etc.).
- (2) Parts partly controlled (fuel system, hydraulic and electrical equipment, armament provisions, etc.).
- (3) Parts beyond immediate control (engines and purchased equipment, etc.).

Division (1) amount to between 35 % and 50 % of the weight empty, (2) 10-15 % and (3) 45-50 %. It thus appears that roughly half the estimated empty weight of the aircraft is subject to control of the weight section. The saving of 1 lb. weight in an aircraft represent a saving of about \$10 in manufacturing cost and is worth about \$100 a year in pay load to the transport company. A 10 % increase in gross weight means a 25 % increase in power to reproduce the standard take-off, and a 13 % increase in power to obtain the standard rate of climb.

Weight control is thus of the utmost importance. The stress department must be made "weight conscious" and allowance for "unknowns" must be done away with.

Progress would be more rapid if detailed weight schedules of all successful models could become generally available.

(Communicated by D.S.R., Ministry of Aircraft Production).

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"PRESIDENT ROOSEVELT, IN THE LETTER OF INTRODUCTION HE GAVE TO MR. WENDELL WILKIE, WROTE THE FOLLOWING VERSE FROM LONGFELLOW, WHICH, HE SAID, 'APPLIES TO YOU PEOPLE AS IT DOES TO US':—

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X-Ray Analysis in Industry. (*J. Sc. Inst.*, July, 1941, p. 126).

The second part of this Symposium is reproduced in this issue and is devoted to the technique of X-Ray analysis methods and some recent developments. Thirteen papers are recorded and include the following:—Photometry of X-Ray Crystal Diffraction Diagrams, a simple photometer for the examination of X-Ray films, experimental technique in the study of alloys by X-Rays, X-Ray crystal photography at low temperatures, measurement of stress by X-Rays, some applications of X-Ray methods in the examination of organic crystals, the derivations of lattice spacings from Debye-Scherrer photographs, systematic determination of crystal orientation, some applications of X-Ray technique to the study of preferred orientation of crystals in metals, superlattices, X-Ray diffraction and the deformation of metals, precipitation in the solid state and particle size measurement by the X-Ray method.

(Abstract supplied by Research Department, Met. Vick.).

Method of Selection of Ball and Roller Bearings—Parts I and II, by G. F. A. Ungar. (*The Machinist*, August 30, 1941, Vol. 85, No. 23, p. 192E, 1 fig. September 20, 1941, Vol. 85, No. 26, p. 214E, 2 figs.).

Part I. Manufacturers' catalogue ratings are based on different test methods and lengths of expected life—factors which lead to wide variations in catalogue load-capacity ratings for the same type and size of bearings of different makes. It is necessary to reduce all calculations to an equivalent standard for comparison. The necessary formulae are given and a typical example of a rotary gear pump with needle bearings is evaluated.

Part II. Examples of bearing selection for modern machine tools including bearings for milling machine spindle head and the bearings for portable electric saw.

Technical Control in Electroplating. (*Met. Ind. (Lond.)*, August 1, 8, 1941, Vol. 59, Nos. 5, 6, p. 66 and 84).

Research and laboratory development; works control by inspection reports and routine analyses; specifications; standard practice for Ni, Cr, Ag, Cu, Cd, Au, Zn, Sn; shop records and observations.

(Communicated by the British Non-Ferrous Metals Research Association).

Thermometric Time Lag, by R. Beck. (*Transactions of the A.S.M.E.*, August, 1941, Vol. 63, No. 6, p. 531, 16 figs.).

Facts and theory of thermometric time lag in a form suitable for industrial users of thermometers. The emphasis will be on the distant-reading type of thermometer, actuated by liquid expansion (mercury or other liquids), gas expansion, or vapour pressure, and mercury-in-glass thermometers.

The Sheffield Precisionaire Air Flow Gauge. (*Machine Tool Review*, June, July, August, 1941, Vol. 29, No. 178, p. 56, 5 figs.).

Diagram illustrating the principle of the precisionaire gauge. Precisionaire gauge for heavy work and for components which must be gauged on the machine. Precisionaire gun bore gauge showing long tubular handle, gauging nose and flexible tube connection to the instrument. Checking gun bores. Two gauges are used one for the bore and one for the rifling grooves.

Gauging Recesses, by L. H. Leedham. (*Machinery*, September 11, 1941, Vol. 58, No. 1509, p. 655, 4 figs.).

The gauging of turned recesses always presents difficulties, especially when the width of the recess is small. Special gauges suitable for measuring these recesses are described in detail.

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MECHANICS, MATHEMATICS.

Stress and Deflection in Reciprocating of Internal-Combustion Engines, by R. L. Boyer and T. O. Kuivinen. (*Transactions of the A.S.M.E.*, August, 1941, Vol. 63, No. 6, p. 499, 5 figs.).

A consideration of stresses and deflections in reciprocating parts of internal combustion engines from the viewpoint of the heavy-duty-engine builder. Rules for design of pistons, piston pins, connecting rods and piston rods, bolts and connecting rod caps.

METALLURGY OF STEEL.

Stainless Steel and Aircraft Trends, by M. Walter. (*Aero Digest*, May, 1940, p. 8, B.N.F. Serial, 23, 648).

Compositions and properties of 18-8 stainless steels; applications in principal aircraft structures, secondary structures and non-structural parts; welding; press working of sheet; assembly; maintenance; repairs.

(Communicated by the British Non-Ferrous Metals Research Association).

Contribution to the History of the Development of Sintered Hard Metals (G), by F. Skaupy. (*Metallwirtschaft*, May 23, 1941, Vol. 20, No. 21, p. 537).

Notes on the companies (German and American), concerned in the early development of sintered hard carbides, with the appropriate patents.

(Communicated by the British Non-Ferrous Metals Research Association).

Chemical Composition of SAE Steels—I and II. (*The Machinist*, September 27, 1941, Vol. 85, No. 27, p. 557).

Revised series by the Iron and Steel Division of the SAE Standards Committee. The composition limits of SAE steels apply to the steels as delivered to the purchaser. Part I includes carbon steels, free cutting steels, manganese steels, chromium steels. Part II includes nickel steels, nickel chromium steels, chromium nickel austenitic steels—not capable of heat treatment, stainless chromium irons, molybdenum steels, chromium vanadium steels, silicon manganese steels.

PLASTIC MATERIAL.

Can Plastics Replace Metals? by Herbert Chase. (*The Machinist*, September 20, 1941, Vol. 85, No. 26, p. 527, 4 figs.).

They have already done so for certain applications, and war time economy may speed up the process. In making a change, the limitations must be remembered. In a normal economy, plastics can take the place of metals only where they provide either a product of lower cost or a balance of advantages not realized more cheaply by some other means.

A New Plastic Material. (*Inter. Avia.*, U.S.A., No. 770-71, June 27, 1941, p. 17).

A construction material which apparently is particularly suitable for the aircraft industry has been developed under the designation *Fybr-Tech*. It consists of a single layer of wood with a layer of artificial fibre bonded by means of artificial resin to each side. The strength of this very light material is stated to be exceedingly satisfactory. *Fybr-Tech* can readily be sawed, drilled and stamped, immaterial of the direction of the grain, and can be formed under the application of heat without detrimental effect on the surface. Its resistance to meteorological influences is stated to be very good. The idea of using several laminated materials in the

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construction of aeroplanes is not new and has been adopted in France some considerable time ago. For example, the well-known "Plymex" skin, consisting of three-plywood on which aluminium sheet was bonded by means of casein for the absorption of torsional stresses, was extensively used in the construction of the Morane 406 single-seater fighter.

(Communicated by D.S.R., Ministry of Aircraft Production).

Synthetic Resins as Aircraft Construction Materials—Part II. (*Inter-Avia.*, No. 774, Ju'y 23, 1941, pp. 1-5. Part I, No. 772, 773, No. 28302).

(1) Properly selected synthetic resins have the following properties which make them suitable for the aircraft industry: Good mouldability, low specific weight, smooth surface, low inflammability, resistance to chemicals and bacterial growths, low hygroscopicity, great energy absorption for oscillation damping, manufacture from non-strategic raw materials.

(2) Synthetic materials suitable for the manufacture of entire airframes without stiffening additions are not known at present.

(3) The strengthening of synthetic resins to the values required for the manufacture of aircraft by means of fabric fillers is not excluded; however, materials of this class ready for use are not yet available.

(4) Wood improved by means of synthetic resins and plastics strengthened by means of wood layers are widely and advantageously adopted today.

(5) Methods and installations for the industrial manufacture of airframe components from compound wood-plastic materials are available.

(6) The "plastics aircraft" available today are made exclusively of wood improved by synthetic resins on the principles of conventional plywood construction under the application of the processes in question for the manufacture of shell components.

(7) The development of a method for the construction of wood-plastics aircraft in which the properties of the new compound materials are fully exploited with a view to reducing the manufacturing time, the quantity of material needed and the weight, and to adapting them to the static and aerodynamic requirements, is still in its infancy.

(Communicated by D.S.R., Ministry of Aircraft Production).

SMALL TOOLS.

How to Use Dressing Tools. (*Industrial Diamond Review*, August, 1941, No. 9, p. 54, 4 figs.).

Special methods for truing stepped wheel faces by means of diamond tools.

A New Diamond Drill Bit, by D. A. P. Wilson. (*Industrial Diamond Review*, August, 1941, No. 9, p. 57, 1 fig.).

Effect of loading diamond crowns above and below the critical value.

Sharpening Milling Cutters. (*Machinery*, September 4, 1941, Vol. 58, No. 1508, p. 627, 2 figs.).

From an article written by the cutter grinder foreman of Cincinnati Milling Machines and Grinders, Inc. including grinding data for solid milling cutters and grinding data for inserted blade milling cutters.

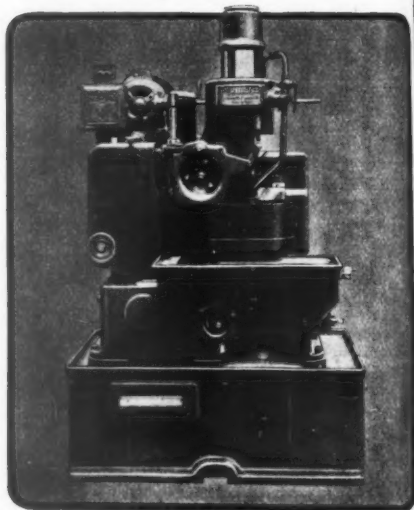
Hints on Die Making, Part I and II, by Albert Huff. (*The Machinist*, September 13, 1941, Vol. 85, No. 25, p. 503, 5 figs.).

The hints refer to the actual manufacture of dies including grinding, drilling, templet making and lining up of parts.

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Press Tools for the Production of Small Drawn Parts, by E. Roe. (*Machinery* August 28, 1941, Vol. 58, No. 1507, p. 600, 8 figs.).

The tooling described has been designed to produce comparatively small components from cartridge brass. Layouts with standard times for the various operations are given.

STANDARDISATION.

New British Standards for Limits and Fits and Limit Gauges. (*The Machinist*, September 13, 1941, Vol. 85, No. 25, p. 206E, 3 figs.).

Two new specifications on limits and fits and limit gauges are being issued. One relates to tolerances on plain gauges, and the other is a revision of the existing British standard 164 on limits and fits. They are obtainable from the British Standards Institution, price 2s. 3d. each, post free.

SURFACE, SURFACE TREATMENT.

Friction and Surface Finish (M.I.T. Symposium). (Various authors, *Metal Industry*, Vol. 59, No. 6, August 8, 1941, p. 89).

The mechanism of wear is discussed and classified under the following headings: Cutting due to rough surfaces; abrasion by hard particles; corrosion by chemically active materials in the environment; galling due to molecular forces between metals as modified by surface films; and, finally, pitting caused by the fatigue cracking of promontories on the surface. The belief is expressed that all of these types of wear, except that of cutting wear, are important in service.

In the discussion which followed, reference was made to the use of extreme pressure lubricants for "running in" operations, since these have a residual beneficial effect in reducing the wear of the metal parts, even when the lubricant is only plain mineral oil. References were also made to galling between mating surfaces, the formation of cocoa or fretting corrosion, and the actual welding of parts in service.

(Communicated by D.S.R., Ministry of Aircraft Production).

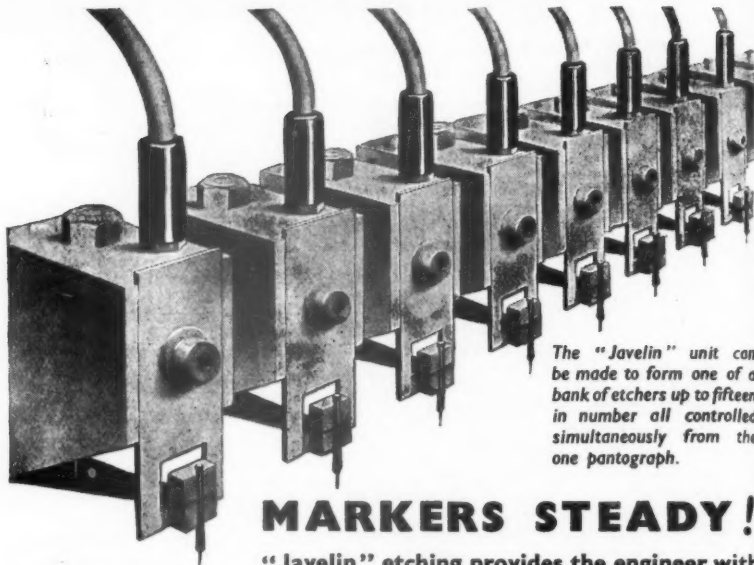
Chrome Plating Engine Cylinder, by H. Van der Horst. (*Mechanical World*, September 19, 1941, Vol. CX, No. 2855, p. 191, 1 fig.).

The process must meet certain fundamentals: (1) The electrolytic coating must adhere perfectly; (2) The thickness of the coating must, within limits, be equal all around and from top to bottom; (3) There must be no tiny ridges for the piston or the rings to run against; (4) The ordinary bright, dense coating of chromium is not suitable; it does not hold lubricating oil; (5) In order to hold oil, it is essential that the chromium be very porous. Treatment of ports of cylinder liners for chromium application.

WELDING, BRAZING, SOLDERING.

Automatic Arc Welding. (*Mechanical World*, August 29, 1941, Vol. CX, No. 2852, p. 135, 7 figs.).

Arrangement and method of operation of relays in automatic welding head. Types of automatic welding heads. Electrode feeding device. Welding current diagram. Stationary welding head engaged on the production of welded wheels. Tractor type head. Arc length control. Continuous filler wire unit.



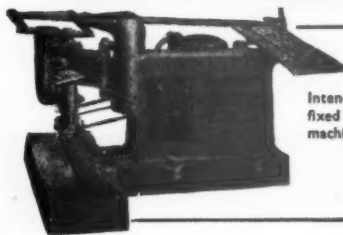
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High Speed Welding by S. G. P. De Lange and E. S. Waddington. (*The Welding Industry*, September, 1941, Vol. IX, No. 8, p. 194, 1 fig.).

Welding procedure. Comparison test of welding speeds between normal and high speed electrodes. Example selected at random of the penetration obtained with high-speed electrodes during the tests. De-slugging. Economies.

Weldability—Base Metal Cracks. (*Spraeragen, Claussen. Weld J.*, 1941, p. 201).

This review deals with cracks which started in the base metal before the welded part was placed in service. The various aspects of the problem are dealt with in considerable detail and a bibliography of 147 references is appended.

(Abstract supplied by Research Department, Met. Vick.).

The Electric Welding of Steel Structures in the Department of Main Roads, by G. H. Linton and V. Karmalsky. (*The Australasian Engineer*, July 7, 1941, Vol. 1, No. 302, p. 10, 4 figs.).

(1) Forge or fire welding; (2) Gas welding; (3) Thermit welding; (4) Resistance welding; (5) Electric arc welding. The illustrations show: welding members on the new Hawkesbury bridge; the Barraba bridge, showing the 100 ft. high portals; welded girder for the Broyo bridge with span of 110 feet.

Which Electrode? by E. W. P. Smith. (*The Machinist*, August 23, 1941, Vol. 85, No. 22, p. 421, 4 figs.).

To make an intelligent electrode selection, it is necessary to know the physical properties required, the type of joint, the position in which the weld is to be made, and the condition of work fit-up, etc. The chief characteristics of basic types of electrodes are given in this article.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—The addresses of the publications referred to in these abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.

ANNEALING, CASE-HARDENING, TEMPERING.

Heat Treatment of Molybdenum High-speed Steels. (*Mechanical Engineering*, October, 1941, Vol. 63, No. 10, p. 703, 3 figs.).

Compositions for molybdenum high-speed steels. Type I, Molybdenum-tungsten; Type II, Molybdenum-vanadium; Type III, Tungsten-molybdenum. Forging. Annealing. Hardening. Quenching. Straightening. Tempering. Coatings. Salt-bath furnaces. Salt baths for hardening. Procedure for salt-bath hardening. Effect on salt-bath hardening. Characteristics of atmospheres capable of protecting molybdenum high-speed steels. Preheat temperatures. High-heat temperatures.

Automatic Camshaft-hardening Machine. (*Engineering*, September 5, 1941, Vol. 152, No. 3947, p. 186, 5 figs.).

The camshaft hardening machine is stated to be capable of hardening the lobes of from 30 to 50 cast-iron or steel shafts per hour, and, as the heating and quenching operations are under automatic control, uniformity of treatment is ensured. Except for the loading and unloading of the work piece, the operation of the machine is entirely automatic. The machine uses oxycoal gas as the heating medium.

BELTS, ROPES.

Belting Joints, by H. Stuart Jude. (*Power Transmission*, October, 1941, Vol. 10, No. 117, p. 389, 6 figs.).

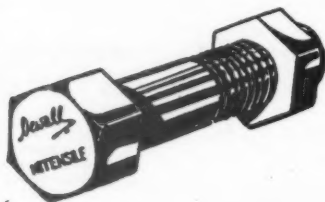
Except for the comparatively few belts which are manufactured endless (such as cord belts, woven endless cotton, and some—but certainly not all—V-ropes), belts used on transmission drives must be jointed in one way or another. Leather lacing. Light hinged metal joints. Heavy hinged metal joints. Plate fasteners. Bar-type fasteners. Belt splices.

COOLANT, LUBRICANT.

Self-Lubricating Bushes: Notes on Manufacture and Application. (*Automobile Engineer*, August, 1941, Vol. 31, No. 413, p. 248).

Notes on preparation of powdered gunmetal, brass, or other Cu alloy, stressing the importance of maintaining accurate particle size by careful standardisation of conditions; testing oil-holding capacity; types of bushes produced and their fields of application.

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ELECTRICITY.

The Control of the Domestic Load, by P. Schiller. (*The Journal of the Institution of Electrical Engineers*, October, 1941, Vol. 88, Part II, No. 5, p. 373, 13 figs.).

After a brief review of the characteristics of the three principal components of the domestic thermal load, viz., electric cooking, water heating, and space heating, the influence of intensive domestic electrification on the load factor of undertakings is investigated. As a result it is contended that with present methods of developing the domestic load the maximum attainable load factor of the latter eventually does not much exceed 30%. A new method of centralized load control enables the demand of individual domestic installations to be limited to values that can be adjusted progressively in accordance with the system load. Some recommendations as to future policy with regard to domestic electrification are put forward.

Metal Rectifiers, by A. L. Williams and L. E. Thompson. (*Journal of Institution of Electrical Engineers*, October, 1941, Vol. 88, Part I, No. 10, p. 353, 16 figs.).

The paper deals in detail only with the two types of metal rectifier which have found general application in industry, namely, the copper-oxide and selenium rectifiers. The history of these is given briefly, with particular reference to the main developments which have brought them to their present state of efficiency. This section leads up to modern methods of manufacture. The fundamental direct-current electrical characteristics, upon which the performance depends, and the manner in which they are influenced by various factors, are described. The simple basic theory which governs all types of rectifier is discussed with reference to metal rectifiers in relation to their chemical and physical forms. Finally, the method by which the correct working conditions are deduced from the characteristics is described.

EMPLOYEES, WORKMEN, APPRENTICES.

Supervision of Apprentices, by O. L. Harvey. (*Personnel*, July, 1941, Vol. 18, No. 1, p. 32).

The various responsibilities of the apprentice supervisor. The different points are the practical considerations encountered in supervising any apprentice programme. The recommendations are based on a long period of observation of the apprenticeship experience of many companies.

FOUNDRY, MOULDING, MELTING; PATTERNS.

Casting in Rubber Moulds, by F. K. Smith. (*Steel*, July 7, 1941, Vol. 109, No. 1, p. 50; *Foundry Trade Journal*, September 11, 1941, Vol. 65, No. 1, 308, p. 169).

Rubber moulds for casting low-melting alloys. Mainly details of production of moulds. No reference to alloys cast.

(Communicated by the British Non-Ferrous Metals Research Association.)

Plaster Patterns, by Henry Plucknett. (*Aircraft Production*, November, 1941, Vol IV, No. 37, p. 13, 12 figs.).

Plaster patterns have proved to be thoroughly satisfactory in use, and have the advantage that they can be produced in a much shorter



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time than wood patterns. In this direction savings can be effected representing about 50% to 75% of the time taken to make a similar pattern in wood. Plaster patterns will not warp, shrink, or twist as wood tends to do when left in the damp sand of the foundry. Plaster patterns can be made directly from a finished part. There would appear to be no critical limit to the size of patterns which may be made in plaster, and units ranging from 2in. square to 10ft. or 12ft. square have been made with complete success. Modifications can be very quickly and easily effected. Illustrations show very instructive applications. A pattern with projecting clamping edges. The use of formers as ordinates to obtain the curve of a skin panel. Preparing plaster. A curved channel in sheet metal, and the first stage in the manufacture of the pattern for the forming punch. Hollow patterns. Clay-cored patterns. Sectional patterns.

GEARING.

Durability of Gears, by H. D. Mansion, (*Automobile Engineer*, October, 1941, Vol. XXXI, No. 415, p. 328, 4 figs.).

Investigations carried out in the research department of the Institute of Automobile Engineers. Under testing conditions failure can occur either by breakage of teeth or by surface deterioration. A special design of gear was necessary to avoid breakage so as to bring to light the surface strength of the materials. The blend of the fillet is believed to have a considerable effect on the fatigue strength of the teeth, as almost all the tooth fractures have started from this point, a few only having started from near the pitch line. An explanation of the terms scoring, scuffing, ridging, spalling, and pitting is given. A full description of the tests is given, including tables of results and photographs of examples of failures occurring during test. A future programme for the continuation of this research is also given.

HYDRAULICS.

Hand Hydraulics, by Karl Kuehn. (*The Tool Engineer*, September, 1941, Vol. X, No. 9, p. 51, 9 figs.).

How high-pressure hydraulics has been developed and applied to tools which find many applications. Pressures from 3,000 to 10,000 lbs. per square inch. Hydraulic jacks. Extremely high efficiency from 90% to 95%. The hydraulic ratio. Combined advantage of mechanical and hydraulic means. Design of a modern hydraulic. Several advantages in using remote control equipment. Chief among these is the fact that the lift ram can be used in any plane.

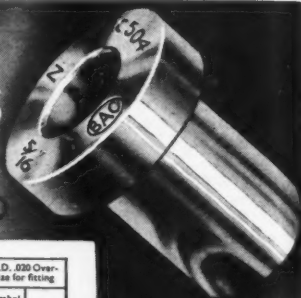
LIGHTING.

Blacking-out 550,000 square feet of Roof Lights in 15 seconds. (*Industrial Power and Fuel Economist*, September, 1941, Vol XVII, No. 192, p. 121, 6 figs.).

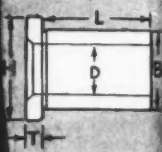
The installation provides for "blacking-out" the factory in 15 seconds by pressing a button and doing the reverse process in the same way and in the same time. Illustration shows method of fixing movable shutter over the North Lights. Central control.

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	No. 22 Drill to 5/16	1/2	5/16	7/32	39/64	B 502	3/3	B 602	2/9
2	Letter "O" to 1/2	3/4	3/4	7/32	59/64	A 503	2/6	A 603	2/6
	33/64 to 3/4	1	3/4	5/16	1-15/64	B 503	2/9	B 603	2/6
	49/64 to 1	1-3/8	1	3/8	1-39/64	C 503	3/3	C 603	2/9
	1-1/64 to 1-3/8	1-3/4	1-3/8	3/8	1-63/64	A 504	2/6	A 604	2/-
3	1-25/64 to 1-3/4	2-1/4	1-3/8	3/8	2-31/64	B 504	2/9	B 604	2/3
			1-3/4			C 504	3/-	C 604	2/6
						A 505	2/6	A 605	2/-
						B 505	2/9	B 605	2/3
4						C 505	3/-	C 605	2/6
						A 506	3/6	A 606	3/-
						B 506	3/9	B 606	3/3
						C 506	4/-	C 606	3/6
5						A 507	5/-	A 607	4/3
						B 507	6/-	B 607	5/3
						C 507	6/6	C 607	5/9
						A 508	6/6	A 608	5/6
6						B 508	7/3	B 608	6/3
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PRODUCTION ENGINEERING ABSTRACTS

MACHINE-ELEMENTS.

Ball and Roller Bearings, by B. Pringle. (*Power Transmission*, October, 1941, Vol. 10, No. 117, p. 404, 13 figs.)

The author discusses the application of ball and roller bearings for electric motors—their possible sources of trouble, and how to overcome them. Operating conditions. Possible troubles. Errors of mounting. Lubrication. Effect of water and acid. Cage wear.

Selection of Ball Bearings, by J. S. Tawresey. (*The Tool Engineer*, September, 1941, Vol. X, No. 9, p. 45.)

Self-aligning ball bearings. Single row groove type. Double row groove type. Single row angular contact type. Supplementary types include adapter sleeve bearings derived from the self-aligning type; and single and double plate seal bearing, and snap ring bearings derived from the single row groove type. Basically the choice of bearing type is dependent upon the character of the load to be provided for and consideration of requirements as to yield and deflection. The load-life principle is applied by equating a suitable measure of the demand made by operating conditions to a corresponding measure of the performance of any given bearing. A chart and a nomograph illustrate the relations of: Normal average load in pounds; average speed in r.p.m.; reference rating of the bearing; design life obtained from the bearing. Reference rating is specifically the load capacity of the bearing when operating at a speed of 1,000 r.p.m. and for a design life of 1,000 hours. Design life is the life which will be attained by at least 90% of a group of bearings subjected to the given operating conditions. The maximum load to be applied to any bearing should not exceed an amount equal to five times the reference rating value.

Method of Selecting Ball and Roller Bearings—II. (Ungar, *Machinist*, 20/9/41, No. 214, 2 figs.)

In this article the author shows the method of selection of a bearing for the spindle head of a typical plain milling machine. A minimum life expectancy of 10,000 hours is assumed, and also that the motor is always operating at its maximum horse-power and speed. Results from two equations previously recorded by the author are tabulated, and from these suitable bearings for a portable electric saw are chosen.

MACHINING, MACHINE TOOLS.

Troubles Experienced with Automatics: Their Cause and Cure, by E. E. Fluskey. (*Machinery*, October 16, 1941, Vol. 59, No. 1514, p. 71.)

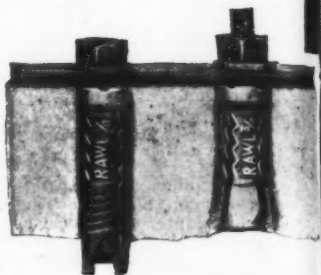
The Swiss type of automatic is primarily intended for turning long slender spindles, pinion blanks, etc., where the length is many times greater than the diameter. They are, of course, capable of producing any component which can be machined from the bar at one chucking. The radical difference from the general type of automatic is that the turning tools have no lateral movement in their slides and tool boxes except for adjustment to align the tools with each other. An important feature is that when the machine is set up to produce long slender work, the bar of material is run through a guide bush which is set as close as practicable to the tools. Troubles experienced in maintaining diameters. Surface speeds for Swiss type machines. Troubles arising from length variations. Turning feeds for machining with guide bushes.

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Guide bush seizures. Cutting-in feeds for machining with guide bushes. General hints for efficient operating. Guide bush materials. Drilling and threading.

Deep Hole Drilling, by C. D. Mackinnon. (*Machine Shop Magazine*, October, 1941, Vol. 2, No. 10, p. 66, 4 figs.)

Deep drilling small diameter holes is a fairly simple matter provided drills of correct diameter and length of flute are to hand, but in general production shops undertaking a wide range of work such drills are not always obtainable. Sources of trouble: (1) Unfair wear by either indolence or lack of interest of some operators or keenness and anxiety to achieve high production of others; (2) Impossibility of removal of swarf in drilling holes of, e.g., $\frac{3}{4}$ in. diameter by 25in. deep with the ordinary drill flute. Residue of fine swarf particles at the bottom of the hole. Remedy: Periodical withdrawal of the drill or clearing by scraping out the cuttings, etc. Another method for overcoming the trouble of binding due to the drill being undersize at the cutting end is to grind the cutting faces "off centre", by a slight amount, to cause the drill to cut an oversize hole. Inverted drilling. Large diameter holes. Examples: 4in. diameter by 35 $\frac{1}{2}$ in. long, 50 tons tensile; 3in. diameter by 30in. long. Increase of tool-life by the Macrome process. Stellite carbon steel drills to preserve flute length. The revolvable drilling jig. Operating the revolvable jig.

The Automatic Step-drilling of Deep Holes. (*Machinery*, October 23, 1941, Vol. 59, No. 1515, p. 96, 1 fig.)

Diagram of Leland-Gifford hydraulic step-drilling mechanism. Type of drill used. Drill coolant. Length of drilling step. Rate of feed and cutting speed.

CHIPLESS MACHINING.

Deep-drawing and Pressing of Aluminium and Light Alloy Sheet, Parts I and II, by J. D. Jevons. (*Met. Ind. (Lond.)*, August 29, September 5, 12, 19, 26, 1941, Vol. 59, Nos. 9, 10, 11, 12, 13; pages 130, 146, 165, 178, 197.)

Describes technique used for deep-drawing and pressing aluminium non-precipitation-hardening alloys, and precipitation-hardening alloys of the single and double-heat treatment types. A full discussion of the furnaces and control methods for the heat treatments necessary is included.

(Communicated by the British Non-Ferrous Metals Research Association.)

The Use of Rubber in Conjunction with Press Tools, by F. L. Joyce. (*Machinery*, October 9, 1941, Vol. 59, No. 1513, p. 29, 13 figs.)

Amount of useful work possible in one stroke on the rubber press. Piercing and flanging. Set-up for piercing a flanged hole. Result obtained with the set-up. Views showing why a small radius is preferable to a large radius when forming small flanges. A typical set-up employing an auxiliary rubber bed. Sectional view of component which requires flanging in two directions. Set-up for producing a straightforward double bend. Set-up for double flanging in opposite directions. The rubber bed. Component requiring a V-bend. Result obtained by external pressure. A typical shape for which the rubber pressing process is unsuitable. Friction between the metal being worked and the rubber bed.

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MANUFACTURING METHODS.

The Manufacture of Bundy Tubing. (*Machinery*, October 23, 1941, Vol. 59, No. 1515, p. 85, 12 figs.)

The manufacture of small diameter tubing by the Bundy process. Produced from strip steel and with a double wall, Bundy tubing has a clean coppered interior, a tinned corrosion-resistant external surface, and a consistently uniform wall thickness. Bundy tubing comprises two tubes of steel strip wrapped one around the other with their seams diametrically opposed. The tubing is despatched from the works in the form of straight lengths or in coils. The tubing is used chiefly for petrol and oil lines for motor-cars and for the operation of hydraulic brake gear. The outstanding characteristic which makes the tubing suitable for use on motor-cars is its resistance to vibration-fatigue as compared with the copper tubing. Diagrams showing the forming of the two strips in the manufacture of Bundy tubing. The forming rolls for the manufacture of Bundy tubing. Views showing the brazing furnace of the automatic plant. Leaving the annealing tube, the work passes through the tinning chamber. Drawing showing the details of the hand tools employed for flaring. Dies used for the flaring operation. A typical bending fixture Bundy tubing.

When You Machine Stainless, by W. B. Brooks. (*The Machinist*, October 18, 1941, Vol. 85, No. 30, p. 643, 2 figs.)

Recommended practice: (1) Use liberal rake and clearance angles; (2) Employ sulphur and sulphur-chlorine cutting fluids liberally to lubricate and cool the tool and work; (3) Use first quality high-speed steel tools; (4) Keep the tools sharp and smooth. Hone after grinding. (5) Use a generous feed and cut below the work-hardened surface resulting from the preceding cut. Use rigid equipment having sufficient power to assure continuous cutting; (6) Reduce cutting speeds 20 to 50% from those used on machine steels; (7) Support the tools rigidly.

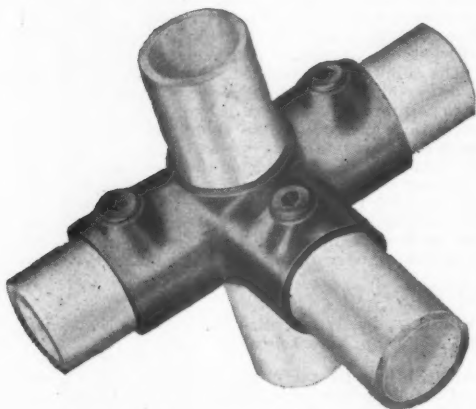
Assembling the Beaufighter, by Bruce Foster. (*Aircraft Production*, October, 1941, Vol. III, No. 36, p. 347, 23 figs.)

The Bristol Beaufighter is powered by two 1,400 h.p. Bristol Hercules sleeve valve engines, and has a nominal maximum speed in excess of 330 m.p.h., with long range and unusually heavy armament. The modern method of dividing the structure into separate assemblies is particularly adaptable to this machine. Excellent results are being obtained, and no difficulty is experienced in the assembly of the various components.

Wright Turns to Line Production, by P. W. Brown. (*The Machinist*, October 4, 1941, Vol. 85, No. 28, p. 595, 45 figs.)

By adopting the "in-line" principle of mass production and by installing specially designed multiple-tooled machinery, Wright Aeronautical Corporation has found it possible to increase output at Paterson, New Jersey, almost six times while floor space has been expanded only about three and a half times, and manpower has been tripled. Forty-five figures illustrate the whole manufacturing process. The working force in the Paterson area has been enlarged from 5,175 persons in 1939 to more than 17,000 at present.

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Originality of the Bell Airacobra. (*Aircraft Production*, October, 1941, Vol. III, No. 36, p. 364, 13 figs.)

All-metal stressed-skin construction. Engine submerged amidships. Tricycle undercarriage. Twenty thousand man-hours for production.

The Blackburn Botha, by Wilfred E. Goff. (*Aircraft Production*, November, 1941, Vol. IV, No. 37, p. 26, 35 figs.)

Part I, Tubular construction for stressed-skin metal wings. Manufacture of wing spars. Centre plane production.

Reconditioning of War-damaged Machine Tools. (*Machinery*, 18/9/41, p. 673, 13 figs.)

The article describes methods employed in the Ministry of Supply Reconditioning Scheme to repair machines damaged either by enemy action or those worn in service. Machines damaged by high explosives are generally less difficult to deal with than those damaged by fire. Not only are the latter usually out of alignment, but they have lost their original heat-treated properties. The replacement by welding or re-casting of broken or buckled castings is described, as well as the loosening of solidly corroded moving parts. Worn parts may be built up by metal spraying. Many details are given of checking the alignment of bedways, tables, and spindles, including makeshift emergency repairs.


MATERIALS, MATERIAL TESTING.

Deflection of Cast Iron at High Temperatures, by L. W. Bolton. (*The Engineer*, September 12, 1941, Vol. CLXXII, No. 4470, p. 172, 10 figs.)

Ordinary grey cast iron fails at high temperature through growth and scaling, but special irons have been developed in recent years which possess resistance to a marked extent to both these effects. The relative resistance to deformation under light load at high temperatures of various types of heat-resisting cast irons which are now available has been investigated. The method of testing consists essentially of transverse loading a bar of standard dimensions at one end, while the other end is rigidly held, the stressed portion of the bar being held at a predetermined constant temperature. Details of the apparatus used and the method of carrying out the test are described. After consideration of the various industrial applications in which cast iron is used at high temperatures, it was decided that information was most needed on its resistance to deformation at between 800°C. and 900°C. A temperature of 850°C. was therefore chosen for the investigation. The article deals with the influence of silicon content, phosphorus content, and graphite size on the rigidity of cast iron at 850°C.

Three plain carbon steels were tested in order to obtain a comparison between their resistance to deflection at 850°C. and that of cast iron. Normal engineering irons have little resistance to growth and scaling, and will, of course, fail from these causes under prolonged heating. High-silicon cast irons of the Silal type were found to have a good measure of stiffness at 850°C. Higher-silicon irons (7.9 per cent of silicon) have an excellent resistance to scaling and growth, and an increased resistance to deflection. Such irons are capable of undergoing considerable deflection at 850°C. without fracture. The high-silicon acid-resisting type of iron (14 per cent of silicon) was found to be very rigid at 850°C., and although proved to be relatively ductile at a temperature of 850°C. would possibly crack if subjected to rapid changes in temperature. At the temperature

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at which these tests were carried out, additions of phosphorus were found to be beneficial in increasing the resistance of cast iron to deflection. This was particularly so in the case of the higher-silicon irons. It should, however, be noted that the phosphide eutectic melts at a temperature of approximately 960°C., and at temperatures of this order the presence of relatively small quantities of phosphorus is sufficient to cause almost complete loss of mechanical strength. The austenitic irons "Nicrosil" and "Ni-Resist" were found to have a good resistance to deflection at 850°C. As these irons also have a marked resistance to scaling and growth, they are suitable for use under many conditions of service. Graphite size has an important influence on resistance to deflection at high temperatures. Slight differences in graphite size are, however, of less importance than relatively small changes in composition, e.g., in silicon or phosphorus content.

MEASURING METHODS.

Methods of Ensuring Interchangeability, by B. Kaiser. (*Aircraft Production*, November, 1941, Vol. IV, No. 37, p. 53, 20 figs.)

For aircraft work the equipment to ensure interchangeability can be classified as under: (a) Jig references; (b) jigs and assembly fixtures; (c) gauges; (d) standard parts.

Mechanised Inspection, by J. A. Oates. (*Aircraft Production*, October, 1941, Vol. III, No. 36, p. 357, 16 figs.)

Rotol governor components. One of the most advanced gauging systems in this country for the inspection on a quantity production basis of medium-sized batches is described. Mounted on a single plate, it comprises a complete set of gauges covering every dimension of the component. Moreover, the gauges are so designed that in many cases several dimensions can be checked at a single setting. Each gauge is a separate unit, which may be replaced when worn or if the dimensions of the component are modified. All parts throughout are hardened and ground, and the master gauge plates are in the nature of precision instruments.

Micrometer for Large Lathe Work. (*Machinery*, October 9, 1941, Vol. 59, No. 1513, p. 43, 2 figs.)

Efforts of a lathe operator in trying to maintain limits of plus or minus 0.0005 inch on a shaft 28 inches in diameter. In order to permit accurate measurements of this kind to be taken while the lathe is running, equipment such as that shown was designed. It is very important that the shaft being measured should be kept thoroughly clean. Detailed views of the micrometer head and sensitive "feeler" of the large micrometer.

The Measurement of Flame Gas Temperatures, by W. T. David. (*The Engineer*, September 19, 1941, Vol. CLXXII, No. 4471, p. 186, 8 figs.)

The measurement of the temperature of flame gases is of considerable industrial importance, but up to the present no satisfactory method has been evolved. This article suggests what would appear to be a reliable method. The sodium method of determining flame gas temperatures is possibly fundamentally unsound, and it is almost certainly valueless on account of the fact that the combustible air gases are never perfectly mixed in practice. A description of four series of experiments using covered and uncovered wires is given.



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MECHANICS, MATHEMATICS.

The Effect of Foundation Stiffness on the Resonant Frequencies of Rotating Machines. (E. H. Hull, *J. App. Mech. (U.S.A.)*, Vol. 8, No. 3, September, 1941, p. 121.)

The work was carried out in an attempt to clarify the problem of determining the effects of elastic foundations under rotating machines on the resonant speeds of those machines. Non-rotating models were used as a medium for studying this problem for reasons of expediency in construction, manipulation, and measurement. These models consisted of a "rotor" mounted in "bearings" on a rigid stator which in turn was supported through a foundation, the stiffness of which could be varied. The behaviour of uniform rods and models of turbo-driven alternator rotors was studied in this apparatus. Results showed a wide variation of certain resonant frequencies of the model system with foundation stiffness, emphasizing the need for careful consideration of the effect of this factor on the resonant speeds of full-sized machines when run on their permanent foundations.

(Communicated by D.S.R., Ministry of Aircraft Production.)

PLASTIC MATERIAL.

A New Synthetic Material. (*Aircraft Production*, November 1941, Vol. IV, No. 37, p. 20, 4 figs.)

Production of lightly-stressed parts from cellulose-fibre laminations: properties and applications of pyram.

Proper Moulds for Plastics, by G. P. Lehmann. (*Machinist*, October 4, 1941, Vol. 85, No. 28, p. 584, 8 figs.)

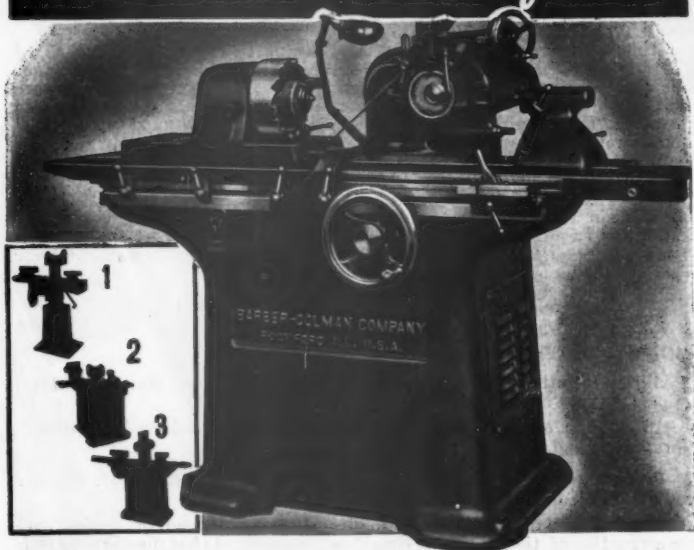
Success or failure of a plastic product may depend on design and construction of the mould. It should be remembered that plastic materials have characteristics as widely different as metals, so the special type of plastic must be known to be used successfully. One of the determining factors in the design of a moulded plastic part is the permissible wall thickness. Hobbed cavities are produced by forcing a hard steel master into a softer steel blank. Extremely large parts have been moulded in England with wall thicknesses of as much as $\frac{1}{4}$ in. to $\frac{1}{2}$ in. Non-uniform sections are apt to cause warping. Where sections are uniform the weight of the part is reduced and a shorter curing cycle may be used. Where threaded inserts are used, it is wise to take precautions to prevent the compound from fouling the thread. When the parting line is projected above one of the adjoining surfaces the flash is relatively easy to clean. Where sufficient compound surrounds the insert, cracks are prevented. Letters frequently are moulded on the surface of plastic parts. A raised letter on a recessed background is the easiest to produce. Plastics moulded parts faithfully reflect the surface of the mould. Therefore, a high surface finish is primarily a question of getting the highly polished surface produced on the steel mould.

SHOP MANAGEMENT.

Supervisors Recommend Own Review Plan, by Thomas G. Newton. (*Personnel*, September, 1941, Vol. 18, No. 2, p. 95.)

Supervisors at the Armstrong Cork Company are rated by a plan they themselves devised. Small discussion groups gave each man a chance to suggest factors he thought should be considered in scoring job

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performance and personality; then the group as a whole decided which points were to be included. The article explains the procedure followed and reports on the system which was finally developed.

The Impact of War-time Conditions and Legislation upon the Function of Personnel Management. (*Labour Management, October, 1941, Vol. XXIII, No. 253, p. 135.*)

The operation of the essential work order. Comment on the White Paper "Welfare Work Outside the Factory." The personnel manager and the employment exchange.

STANDARDIZATION.

Standardization of Aircraft Engine Components. (G. Carvelli, J.S.A.E. (U.S.A.), Vol. 49, No. 1, July, 1941, p. 294.)

Standardization of engine components should start in the drafting room with use of a system of sample drawings, and dimensioning of parts should be simplified through use of a two-place decimal system.

The importance of standardization of notes, clearances, tolerances, and other data listed on drawings is emphasized. In addition, threaded parts, gear tooth form, and many such items can, and should, be standardized, and serious consideration should be given to adoption of the metric system.

Since the Army-Navy (A.N.) Standards were developed primarily for airplanes, and often do not apply to aircraft engines, a new set of standards must be developed for parts used on engines only.

The twenty-odd gauging systems used to-day should be eliminated and only one system used, based on a decimal system. The number and letter drill sizes should be replaced by sizes based on a decimal system. It has been estimated by a firm using copper, brass, and aluminium, that the saving for this firm alone would be over \$1,000,000 a year if a uniform gauge system was used.

The money spent on standardization will pay dividends beyond imagination, and it is recommended that the management of engine and airplane companies encourage their men to serve on S.A.E. committees because without the management's support the work cannot be done satisfactorily.

(Communicated by D.S.R., Ministry of Aircraft Production.)

SURFACE, SURFACE TREATMENT.

Chromium-plating of Cylinders, by H. van der Horst. (*Amer. Soc. Mech. Eng. Paper, June, 1941. Extract in Engineer, August 22, 1941, Vol. 172, No. 4467, p. 123.*)

For satisfactory service in the "Cr." coating on cylinder bores must have good adhesion, be of uniform thickness, and without ridges, and be porous to hold the lubricant. Chrome-hardened, nitrided, or other very hard rings must not be used, but no other changes in engine design or materials are essential. Author mentions U.S. Patent 2,048,578, which deals with anodes. For details of van der Horst process, see Brit. Pat. Spec. 518,694.

(Communicated by the British Non-Ferrous Metals Research Association.)

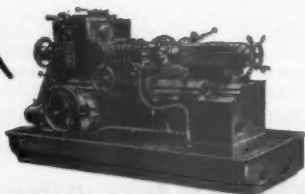
A New Chromising Process. (Rudorff, *Met. Ind.* 26/9/41, p. 194.)

Although there are several ways in which the high corrosion resistance of chromium can be utilised for the protection of iron and steel, the most widely known, chromium plating, requires an inter-coating between

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the steel surface and the chromium layer. The author states that much greater wear resistance and service life can be obtained by resorting to chromium impregnation, the process of which is described, in which an integral surface layer is formed by a diffusion process employing an atmosphere containing chromium chloride.

(Abstract supplied by Research Dept., Met.-Vick.)

Metal Coating of Plastics. (B.I. Plastics and Moulded Product, September, 1941, p. 106.)

It is claimed that in the process of coating plastics with zinc, aluminium, copper, or tin, the metal particles join with the synthetic resin particles and therefore strengthen the surface of the moulded article. The process can also be applied to cast resin and to laminated and cellulose products. Results are given of test carried out to compare the electro-magnetic screening properties of the metal film with tinfoil of the same dimensions.

(Abstract supplied by Research Dept., Met.-Vick.)

Sprayed Coatings—I. (The Machinist, October 11, 1941, Vol. 85, No. 29, p. 619, 9 figs.)

Defects and their correction. Mechanical difficulties. Trouble caused illustrated by nine figures. Table of drop in air pressure. To be expected from various lengths of $\frac{1}{4}$ in. and $\frac{5}{16}$ in. air hose when used with spray gun equipped with air cap consuming approximately 12 cubic feet of air per minute at 60 lb. pressure.

How to Spray Stainless Steel, by C. F. Benner. (Iron Age, July 17, 1941, Vol. 148, No. 3, p. 56.)

Rams for hydraulic presses used in the fabrication of plastics are given sprayed stainless steel coatings in order to eliminate corrosion. Technique of surface preparation (which includes undercutting and grooving), spraying, and finishing is described.

(Communicated by the British Non-Ferrous Metals Research Association.)

Metal-spraying with an Electric Arc Gun. (J. Am. Soc. Nav. Engs. (U.S.A.), Vol. 53, No. 3, August, 1941, p. 688.)

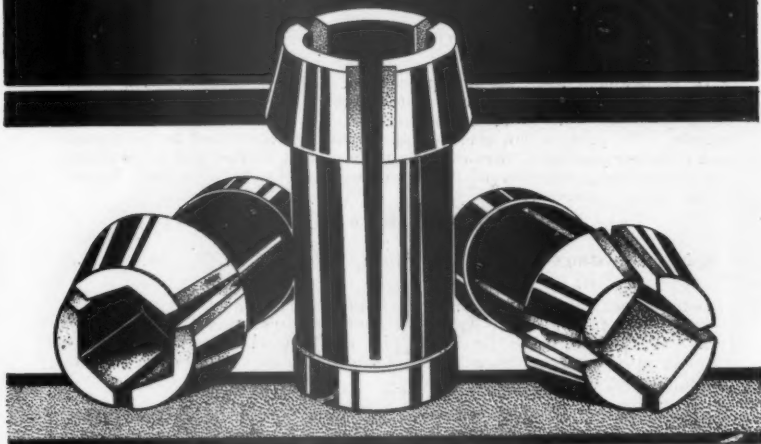
A new method of metal spraying has been developed by Dr. M. U. Schoop, of Switzerland, originator of the metal-spraying process, which makes use of a spray gun utilising an electric arc to melt the metal to be deposited. Hitherto, the metal-spraying process has depended upon a gas flame of some kind to melt the metal before being deposited on the base surface.

The new Schoop process consists essentially of short-circuiting two conducting wires which pass through the spray gun, atomising each drop of metal melted by the resulting arc, and projecting the atomised metal by means of a compressed air blast on the surface to be metallised. A small luminous arc is formed at the breaking point, insuring the continued melting of the wires, which are constantly being fed forward by means of a turbine. Although the compressed air blast directed through the arc may be fed into the gun at pressures ranging from 60 to 120 pounds per square inch, the arc is reported to be entirely stable.

The new process of metal spraying is claimed to be highly economical and efficient. It is said that about 22 pounds of carbon steel or stainless

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steel wire can be sprayed during each hour of operation. In many cases, the pre-treatment of the surfaces by sand-blasting heretofore required, can be dispensed with because of the increased strength of bond secured by this method of deposition. Thus, if a glass plate is electro-metallised with aluminium or steel by this process, and an attempt is made to remove the deposited metal, a layer or "skin" of glass will also be torn off. It appears that owing to the electric arc, the temperature of the sprayed metal particles is so high that they melt into the surface against which they are propelled, rather than becoming merely a surface layer.

(Communicated by D.S.R., Ministry of Aircraft Production.)

TECHNICAL EDUCATION.

The Selection and Training of Inspectors, by J. Tiffin and H. B. Rogers. (*Personnel*, July 1941, Vol. 18, No. 1, p. 14, 4 figs.)

With unit output increasing at an almost unprecedented rate, plant management is being seriously confronted with the problem of maintaining quality. Inspection departments must now operate on the highest possible efficiency level. In this article the authors describe the method of selecting and training inspectors in a tinplate mill. While the conclusions reached may not apply to the inspection of other products, the method employed illustrates principles that could be used in nearly all kinds of inspection work.

Apprentice Training: Routing Schedules, by C. J. Groom. (*Personnel*, September, 1941, Vol. 18, No. 2, p. 85.)

To create a full-fledged craftsman it is essential to teach the apprentice a variety of skills rather than a single operation. In planning the training programme a complete analysis of the trade must be made, showing all the work processes involved and breaking down those processes into "difficulty levels." Procedures are suggested which will facilitate arranging the course and routing the men through it.

WELDING, BRAZING, SOLDERING.

Welding in the Construction of Machine Tools, by F. Koenigsberger. (*The Welding Industry*, October, 1941, Vol. IX, No. 9, p. 227, 6 figs.)

It is generally agreed that, due to the higher tensile strength and the higher modulus of elasticity of steel the sections of a fabricated construction can be much smaller than those of a cast iron casting. Opponents of fabricated work, however, put forward the well-known point that it is not the strength which counts in machine tool construction, but the rigidity against deflections and vibrations. The damping qualities of cast iron are generally acknowledged. To overcome this lack of damping quality of the steel structure, the permissible deformations of the fabricated structure must be lower than those which are permissible for a cast iron structure of the same machine body. To make the design of a machine tool for fabricated construction successful, it is essential that full regard should be paid to the properties of the steel in comparison with those of cast iron. Wall thicknesses and core displacements. Examples: the Discus grinding machine, the A.B.A. jig borer. The Cooke-Ferguson milling machine, the Cincinnati hydraulic milling machine. The designer must not try to imitate the cast iron design. He must not think in terms of cast iron, but in terms of welded steel.



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The Welding of Magnesium, by H. O. Hugland. (*The Machinist*, October 18, 1941, Vol. 85, No. 30, p. 637, 5 figs.)

Both electric resistance and gas torch welding methods now are being used commercially to join magnesium aircraft structures. As magnesium is heated during welding, or cools after the weld is made, it passes through a temperature just below its melting-point, at which its strength is extremely low. Magnesium is susceptible to corrosive action, because of the welding flux used, and care must be taken to remove the flux immediately after welding and to avoid inclusion of the flux within the weld. No flux is needed in electric resistance welding, such as spot, seam, and flash butt welds, all of which are being used successfully with magnesium alloys. Preparation of sheet magnesium for welding depends on thickness of material to be joined. Recommended welding rod sizes. Recommended tip orifices. Machine settings for spot welding. Select electrodes carefully. Control weld zone. Electronic timing desirable.

The New Oscilloscope: An Aid to Good Resistance Welding, by L. G. Levoy, jun., and C. H. Schermerhorn. (*Welding Eng.*, August, 1941, Vol. 26, No. 8, p. 23. *From Gen. Elect. Rev.*, July, 1941.)

A description of a newly developed American instrument, with illustrations of its chief uses in resistance welding, particularly the measurement of current characteristics, such as are of importance in the spot welding of light alloys.

(Communicated by the British Non-Ferrous Metals Research Association.)

Brazing: A Résumé of Modern Practice, by I. Stewart. (*Met. Ind.* (Lond.), August 15, 1941, Vol. 59, No. 7, p. 98.)

Brazing alloys and silver solders; their compositions and properties; fluxes; brazing technique; Cu brazing; resistance brazing.

(Communicated by the British Non-Ferrous Metals Research Association.)

WELFARE SAFETY, ACCIDENTS.

Designing Safety into Punch-press Operation, by Wendell M. Nelson. (*Mechanical Engineer*, August, 1941, Vol. 63, No. 8, p. 577, 6 figs.)

In general, there are four specific steps to be considered when planning a complete punch-press operation: (1) Selection of power press; (2) Determination and design of type of die; (3) Selection of a standard guard, design of a special guard for the particular job, or other provisions for protecting the operator; (4) Adoption of safety regulations. The first two steps must generally be planned together for a particular job, since the necessary die height, length of press stroke, and required tonnage would limit the press size. Steps three and four regard the safety. The illustrations show: (1) Punch press "boxed-in" for automatic operations; (2) The strip feed which allows the material to be gripped and pulled under the enclosed die; (3) The push-slide feed which consists of a manually controlled slide arm, on which the blank is dropped, then pushed into the die and positioned by means of a sliding member; (4) Rotary or dial feed is loaded and unloaded several inches away from ram, which is effectively boxed in.

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Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

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ANNEALING, CASE-HARDENING, TEMPERING.

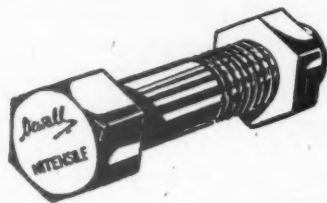
Methane for Gas Carburising, by I. Stewart. (*Mechanical World*, November 28, 1941, Vol. CX, No. 2865, p. 375, 3 figs.).

Methane is the lowest number of the paraffinic group of saturated hydrocarbons and has the formula CH_4 . The essential difference between pack carburising and gas carburising is that in the former a solid charcoal metallic carbonate mixture is used to generate a gas which subsequently effects cementation. In gas carburising, solid compounds are dispensed with and hydrocarbon gas is fed direct into a suitable gas-tight container, in which the work is supported or suspended. Methane will carry some forty times as much carbon to the surface of the steel as butane or propane when each is diluted to a point where sooting is eliminated. Because of its comparatively slow rate of decomposition, methane can be usefully employed in much higher concentrations than either butane or propane which in itself permits of higher rates of gas flow, and therefore more uniform distribution of hydrocarbon with the carburising muffle. Fundamentally, the chemistry of the process is for practical purposes quite simple, and provided the right type of diluent gas is utilised, need be no more than the reactions involved in the breakdown of hydrocarbons to methane, which in turn decomposes to form atomic carbon and hydrogen, the basic reaction being $\text{CH}_4 = 2\text{H}_2 + \text{C}$. Flame control is rendered much simpler when methane is the hydrocarbon employed, due to the fact that in the absence of sufficient hydrocarbon the flame is a clean, lambent, hydrogen flame, whereas with higher hydrocarbons the flame is often coloured with the luminous products of breakdown products, and the maintenance of gas ratios by the flame then calls for some experience.

New Gear-tooth Flame-hardening Machine. (*Iron Age*, (U.S.A.), 28/8/41, p. 57.)

A new machine for flame hardening the surfaces of sprockets, bevel, spur, and internal gears up to 33in. pitch diameter. It is stated that both sides of the tooth are hardened simultaneously without distortion, and that each tooth on the wheel is hardened to exactly the same depth. A non-rusting coolant is used. The machine is fully automatic after starting, even to the extent of indexing, rolling, preheating, and hardening, also stopping the motor and shutting off the gas supply when all the teeth have been hardened.

(Abstract supplied by Research Dept., Met.-Vick.)



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ACCOUNTING, ADMINISTRATION.

The Inclusion of Fixed Overheads in Costs, by Basil Smallpeice. (*The Cost Accountant*, Oct.-Nov., 1941, Vol. 21, No. 5, p. 213.)

The use of costs as an aid to management. The use of costs for stock valuation. Costing is not done for the sake of preparing nice cost figures, but because it is an essential part of the larger task of business management.

JIGS AND FIXTURES.

Working Clamping Devices—I, II, by John G. Jergens. (*The Machinist*, November 15, 1941, Vol. 85, No. 34, p. 750, 14 figs. November 29, 1941, Vol. 85, No. 36, p. 802, 20 figs.)

Part I.—Three major considerations govern the selection of a clamping device for a jig or fixture. The device, first of all, must be strong enough to hold the work. Then it must be rapid in operation so as not to delay the operator in placing and removing the work. Last, but not least, it should be fool-proof—a clamp that does not work properly every time is a constant source of annoyance to the operator and a factor in keeping shop costs high. The devices shown in this group are all designed to hold work down against a jig plate or machine table, and each can be varied in design to suit job conditions.

Part II.—Examples of various types of clamping devices. Double-acting screw clamp. Single-action swinging pinch clamp. Equalizing pinch clamps hold work down. Wedge-type clamp. Simple screw-operated clamp. Screw-type fixture clamp. Long-travel clamp with cam lock, etc.

MACHINE ELEMENTS.

Ball and Roller Bearing Economy, by R. Allen. (*Mechanical World*, November 21, 1941, Vol. CX, No. 2864, p. 355.)

The three stages where action can be taken to avoid unnecessary bearing scrap are: (a) design, (b) maintenance, (c) repair.

Design.—1. Make reference to the two booklets issued in June, 1941, by the Bearing Panel, Ministry of Supply. 2. Consult the bearing manufacturer at the earliest possible stage on bearing selection, design, limits, and lubrication, giving him the fullest possible details. 3. Avoid special bearings. 4. Issue clear and concise instructions to the shops.

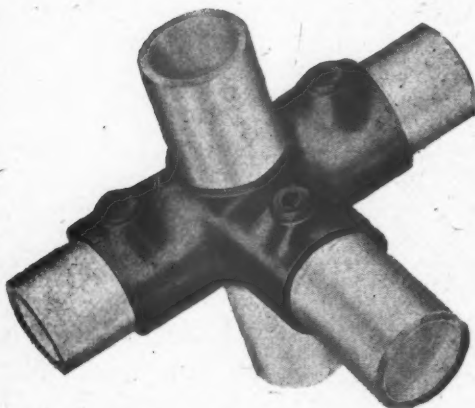
Maintenance.—The maker of a machine should provide every user with the following information: Brand of lubricant to use. When to replenish lubricant. How and when to clean out old lubricant. How to remove and refit bearings when necessary. Complete list of bearings, giving their positions, type numbers, and any special details necessary when replacements are ordered. Brief instructions could be given on a plate attached to the machine.

Repair or Scrap?—Whether a bearing is capable of further service, needs repair, or should be scrapped is a matter that can only be satisfactorily settled by someone having both experience of the machine concerned and of bearings which have seen service in that machine.

The Calculation of the Load Capacity of Ball and Roller Bearings. (R. Mundt, *Z.V.D.I. (Germany)*, Vol. 85, No. 39-40, 4/10/41, p. 801.)

The load capacity and life of ball and roller bearings are matters of great importance. The author reviews the data given by a number of leading German manufacturers for their products over the period 1903 to date. (D. W. F., F. & S., F. A. G., and S. K. F.) The theoretical

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basis of calculations on load capacity and life are next reviewed, and the importance of standardisation in this field is stressed.

In modern engineering indefinite life is scarcely an economic proposition. In most cases the machine incorporating ball or roller bearings is scrapped for various reasons after a relatively short life. The load capacities of bearings, as given by the different manufacturers for their products, generally imply that most of the bearings will have a much longer life than the limits stated. A standard method of calculation would enable the user to select more readily the bearing satisfying his minimum demands.

(Communicated by the D.S.I.R., Ministry of Aircraft Production.)

Band Friction Clutches, by R. Waring-Brown. (*Power Transmission*, November, 1941, Vol. 10, No. 118, p. 426, 6 figs.)

Features of band friction clutches. Theory of band friction clutch. Single band expanding clutch. Coil expanding clutch. Effect of centrifugal force. Single band contracting clutch. Twin contracting band clutch. The external coil clutch.

Weight Reduction in Aircraft Design. (E. E. Roberts, *Aero Digest*, U.S.A., Vol. 39, No. 2, August, 1941, p. 146, 232.)

As recently as 10 years ago the existence of the separate weight department as such was relatively unknown in aircraft plants. Necessary weight and balance calculation were made by personnel who could find the time to do them. Only within the last five years has the weight engineer raised his function from that of estimating, calculating, and recording to one of actual control. The methods by means of which this has been achieved are described by the author with special reference to the Lockheed firm. Success can only be achieved if there exists the closest co-operation between the aerodynamic design and production departments. It is interesting to note that of the total (empty) weight of an aircraft only about 50%, covering the main structural parts (such as wings, fuselage, etc.), is controlled by the firm. The remainder represents purchased equipment (power plant, etc.) or parts supplied by the Government (armaments, etc.).

Excluding such items as ducts, fairings, pipe line and electric wiring, seats, flooring, etc., less than 30% of the empty weight remains in the form of stressed material under full control of the aircraft firm. It is evident that further progress is only possible if the firm or Government departments supplying the non-structural equipment are rendered as "weight conscious" as those responsible for complete aircraft.

(Communicated by the D.S.I.R., Ministry of Aircraft Production.)

MACHINING, MACHINE-TOOLS.

The Honing Process in National Defence, by A. M. Johnson. (*Mechanical Engineering*, U.S.A., November, 1941, Vol. 63, No. 11, p. 811, 5 figs.)

The mechanical idea of the process has been used for many years, but only during the last 15 has that idea been developed into a commercial process. Machines and tools began to appear about 1925, and have undergone a development probably not equalled by any other machining process. With the development of improved machines, tools, and abrasives it became possible to hone soft as well as hardened steels of the various alloys. There are many parts where it becomes necessary to have holes free of scratches, which might cause fractures to develop. This is true in the case of the accessory drive shaft about 4ft. long having



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a $\frac{1}{16}$ in. hole three-quarters of its length and the remainder $\frac{1}{16}$ in. Fractures of this shaft, which occurred when the hole was reamed, were reduced to zero after the honing process was adopted. Verticals have been built with a stroke of 8ft. to hone work up to 30in. diameter. Smaller machines cover the field down to a minimum diameter for which honing tools can be practically made—about 5/16in. Horizontal machines are used extensively for honing cannon from 20mm. diameter up to the largest naval guns. Machines having a stroke of 75ft. have been built for honing work up to 30in. diameter. Most honing tools of the present day are expanded by hydraulic means. In the machine is built a mechanism for performing this function, as well as for controlling the rate of expansion. This rate is timed to the enlargement of the honed hole and to the wearing down of the abrasive sticks. The important requisites of a honing machine are ruggedness and sufficient power, uniform rate of travel, extremely rapid deceleration and acceleration at the ends of the stroke, convenient fixtures for holding the work, and ample quantities of a proper coolant well filtered. The time required to hone a certain piece is dependent upon the accuracy and amount of stock left by the preceding operation, upon the kind and hardness of the material upon the tolerance allowed, and upon the fineness of the finish required. Generally, the honing process is not a difficult one, but at the beginning of a job considerable care should be given to the proper speeds, both rotating and reciprocating, to the intelligent choice of abrasive sticks, and to the best coolant for that particular material. If these conditions are satisfied reasonably well, no trouble should be experienced in producing surfaces, both internal and external, conforming to close tolerances of size and finish.

CHIPLESS MACHINING.

A Continuous Corrugating Press. (*Machinery, November 20, 1941, Vol. 59, No. 1519, p. 208, 5 figs.*)

In order to speed up production several corrugations can be made at each stroke of the press. The possibility of stepping up production in this manner, however, depends on whether or not the material can be drawn. When several corrugations are produced the material is stretched to fill the depression in the die, and is therefore heavily stressed. This may lead to difficulties in certain applications of the corrugated material, and is avoided by making each depression separately. The material is then free to be pushed into the die depression with as little stressing as possible. It was to meet the latter condition that the equipment described was developed.

Hot Pressings from Swarf, by T. Casey. (*Machine Shop Magazine, November, 1941, Vol. 2, No. 11, p. 73, 4 figs.*)

Swarf recovery plant. Castings. Pressings. Hot-press dies. Typical hot pressed shapes.

MANUFACTURING METHODS.

Newly Developed Methods of Making Airplane Templates, by R. A. Von Hake. (*Machinery, November 27, 1941, Vol. 59, No. 1520, p. 225, 11 figs.*)

Work which formerly took weeks is now accomplished in a few minutes by means of photographic and electrolytic processes. Making a master lay-out in pencil on a painted steel sheet or other suitable metal. Setting up a plate-glass negative for a template in front of the enlarging

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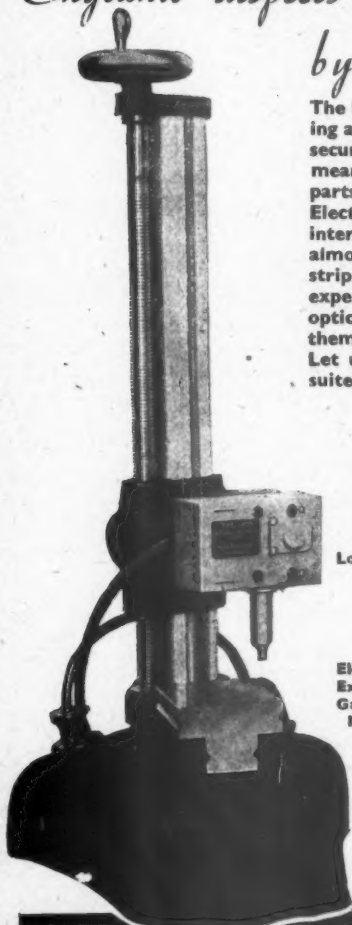
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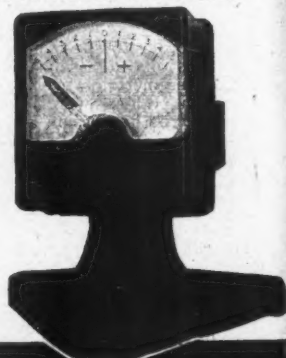
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camera. Cutting out a template according to lines photographed on the sensitized metal sheet. Producing a work template by the electrolytic transfer process. An air-operated press in which the electrolytic transfer process is carried out. Checking the outline of an electrolytically produced template by laying it on the scribed lines of the master lay-out sheet.

Limits of Forging, by G. Sachs. (*Mod. Ind. Press*, March, 1941, p. 2, *B.N.F. Serial*, 24,014.)

Develops a mathematical theory from which it is possible to calculate whether any given article can or cannot be forged without excessive strain on equipment.

(Communicated by the British Non-Ferrous Metals Research Association)

Machining Costs Reduced by the Use of Carbide Tools, by W. J. Williams. (*Machinery*, November 13, 1941, Vol. 59, No. 1518, p. 173, 2 figs.)

Important factors in the selection of the correct types of carbide tools are: the steel to be machined; depth of cut, feed; tool angles, etc. Comparisons are given of machining data for various components using high-speed steel tools and cemented carbide tools. Reduction in cost and time and an increase in the number of components per re-grind are evident from these comparisons. The importance of the correct care of carbide tools is stressed.

The Production of Bomb Sights. (*Machinery*, November 6, 1941, Vol. 59, No. 1517, p. 141, 15 figs.)

Manufacturing methods which ensure a high degree of precision and interchangeability. The use of die castings to eliminate many of the machining operations is illustrated.

The Production of the 40mm. Bofors Anti-aircraft Gun. (*Machinery*, November 27, 1941, Vol. 59, No. 1520, p. 240, 90 figs.)

Reprint of a series of articles since June 27, 1940, until September, 1940.

The Blackburn Botha, by Wilfred E. Goff. (*Aircraft Production*, December, 1941, Vol. IV, No. 38, p. 76, 23 figs.)

Part II.—The outer wing; tail unit and control surfaces; fuel tank construction. The unique tubular construction embodied in the outer wing of the machine is described, together with that of other units of the aircraft. With the exception of the stress-bearing fuel tanks, these are of more conventional construction, but their manufacture is characterised throughout by careful and comprehensive tooling.

Standard Machines for Shell Production. (*The Machinist*, November 29, 1941, Vol. 85, No. 36, p. 807, 20 figs.)

MATERIALS, MATERIAL TESTING.

What Steels to Use, by J. G. Magrath. (*The Machinist*, November 1, 1941, Vol. 85, No. 32, p. 698, 4 figs.)

One of the first considerations in flame hardening is the proper selection of materials to be used. Generally speaking, steels that are hardenable by normal furnace heating and quenching may be flame hardened. Fine-grained steels are usually preferable, as their inherent tendency to resist grain growth is a safeguard against the results of over-heating. The use of steel of improper analysis for flame hardening

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may result in insufficient hardness or cracking from excessive hardening. Alloy steels give tough cores. Suitable flame-hardening steels are indicated in Tables III and IV.

TABLE III.

Type of Steel.	SAE	No.
Carbon	1035	1060
Free Cutting	X1335	X1340
Manganese	T1335	T1340
Nickel	2330	2350
Nickel-Chromium	3130	3140
Molybdenum	4135	4150
Chromium	5140	5150
Chromium-Vanadium	6135	6150

TABLE IV. PLAIN CARBON STEELS.

Classification.	Analysis			Brinell hardness after water quench.
	C.	Mn.	Si.	
SAE X1335	0.35	1.45		500
SAE 1040	0.35	0.80	0.30	580
SAE 1045	0.48	0.68	0.18	630
SAE 1050	0.46	0.69		615
SAE 1055	0.55	0.74	0.22	712
SAE 1095	1.00	0.30		700

Lead-bearing Steels. (*Automobile Engineer*, November 6, 1941, Vol. XXXI, No. 416, p. 586, 2 figs.)

A survey of their properties and their influence on production. Exhaustive tests have demonstrated that the addition of a small percentage of lead under carefully controlled conditions can assist machinability to a remarkable degree, and without any detrimental effect.

Heat-resisting Steels. (*Automobile Engineer*, November 6, 1941, Vol. XXXI, No. 416, p. 571.)

The two most important factors—scaling and creep—affecting steels operating at temperatures in excess of 300° C. are discussed in some detail. The effect of temperature on physical properties is described, and important data derived from investigations carried out in the Firth-Brown laboratories is included.

Substitution of Molybdenum for Tungsten. (*Mechanical Engineering*, U.S.A., November, 1941, Vol. 63, No. 11, p. 798.)

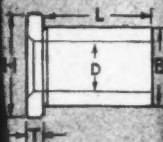
70% to 85% of the tungsten consumption is in high-speed steel, and this constitutes the chief opportunity for conservation. The conservation suggested in this article is by substitution of molybdenum. In some cases other materials could be more suitably substituted, but this article is confined to molybdenum only. Some of these substitutions create new problems and require additional equipment. The range of substitutions includes the conservation of tungsten in alloy tool steels, stellite, tungsten carbide tools, die steels for hot working, valve and valve insert steel, armour-piercing projectiles and bullet inserts, magnetic steels, and, in addition, electrical applications. It is also pointed out that appreciable amounts of tungsten could be made available for use by more complete segregation and the reclamation of tungsten scrap.

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	No. 30 Drill to 5/32	5/16	1/2	1/8	27/64	A 502	3/-	A 602	2/6
			3/4			B 502	3/3	B 602	2/9
			1/2			A 503	3/-	A 603	2/6
2	No. 22 Drill to 5/16	1/2	5/16	7/32	39/64	B 503	3/-	B 603	2/6
			3/4			C 503	3/3	C 603	2/9
			1/2			A 504	2/6	A 604	2/-
3	Letter "O" to 1/2	3/4	1/2	7/32	59/64	B 504	2/9	B 604	2/3
			3/4			C 504	3/-	C 604	2/6
			1/2			A 505	2/6	A 605	2/-
4	33/64 to 3/4	1	3/4	1-15/64		B 505	2/9	B 605	2/3
			1-3/8			C 505	3/-	C 605	2/6
			3/4			A 506	3/6	A 606	3/-
5	49/64 to 1	1-3/8	3/4	1-39/64		B 506	3/9	B 606	3/3
			1-3/8			C 506	4/-	C 606	3/6
			1			A 507	5/-	A 607	4/3
6	1-1/64 to 1-3/8	1-3/4	1-3/8	1-63/64		B 507	6/-	B 607	5/3
			1-3/4			C 507	6/6	C 607	5/9
			1-3/8			A 508	6/6	A 608	5/6
7	1-25/64 to 1-3/4	2-1/4	1-3/8	2-31/64		B 508	7/3	B 608	6/3
			1-3/4			C 508	8/-	C 608	7/-
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A High-temperature Bolting Material, by A. W. Wheeler. (*Transactions of the A.S.M.E., U.S.A., October, 1941, Vol. 63, No. 7, p. 655, 35 figs.*)

In the process of providing new materials or old with improved heat-treatments to withstand the increasing temperatures employed in present-day steam turbines, many studies are being made on alloy steels and their heat-treatment which are most suitable for use as bolting material. This paper reviews a series of tests on heat-treatment, creep, rupture, and hardness, together with the application of the results to bolting-material practice.

Alloy Cast Irons. (*Automobile Engineer, November 6, 1941, Vol. XXXI, No. 416, p. 383, 5 figs.*)

Three of the alloy irons of the Midland Motor Cylinder Co. Ltd. are of particular interest to the automobile industry. These irons are: chromidium for cylinder blocks, heads, crankcases, and brake drums; monidrom for moulded camshafts; and cromol for moulded crankshafts.

Cast Engine Parts. (*Automobile Engineer, November 6, 1941, Vol. XXXI, No. 416, p. 379, 12 figs.*)

Practice employed by Ford Motor Co. Detailed description of the materials used for crankshafts, camshafts, valve seat inserts, push-rods, and valves. The moulding methods employed and the rigorous control that is enforced to ensure castings of the correct quality are described.

The Aluminium Alloys. (*Automobile Engineer, November 6, 1941, Vol. XXXI, No. 416, p. 357, 39 figs.*)

The present survey includes classified summaries in tabular form of the various types of material that will be available. The potentialities of recently evolved alloys and processes are considered in relation to the design of road vehicles.

Principles of Design of Aluminium Pressure Die Castings, by J. Gerber. (*Aluminium, June, 1941, Vol. 23, No. 6, p. 315, B.N.F. Serial, 24,052.*)

Maximum allowable weight and size of casting; dimensional tolerances; maximum and minimum advisable section thicknesses; tapering; corners; edges; holes; threading; inserts; finishing.

(Communicated by the British Non-Ferrous Metals Research Association)

Magnesium from Magnesite (The Hansgirg Process). (*News Edit. (Amer. Chem. Soc.), August 10, 1941, Vol. 19, No. 15, p. 839.*)

In the Hansgirg process magnesium is produced by reducing magnesium oxide with carbon at 2,000° C., cooling the reaction products rapidly with hydrogen to prevent reoxidation of the magnesium. A plant erected for the purpose by the Permanente Corporation at Palo Alto, California, was due to commence operation in August. The process is briefly discussed.

(Communicated by the British Non-Ferrous Metals Research Association)

Modern Views on the Work-Hardening of Metals, by Dr. W. Boas. (*The Australasian Engineer, September 8, 1941, Vol. 41, No. 304, p. 14, 10 figs.*)

The work-hardening effect is intimately connected with the mechanism of deformation. "Amorphous" plasticity is the weakness of metals during any states of transition and transformation. Such transitions are recrystallisation after cold work, allotropic changes, and precipitation of a phase from a supersaturated solid solution. Beilby's "amorphous" theory. Fragmentation. Dislocation.

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MEASURING METHODS. APPARATUS.

Machine-made Inspection, by Herbert Chase. (*The Machinist*, November 29, 1941, Vol. 85, No. 36, p. 793, 6 figs.)

When there are large quantities of small parts to be made, gauging is a time-consuming job. Ford's solution is to gauge automatically. The camshaft gauging machine inspects 600 pieces per hour, and separates non-standard shafts from those within the allowed limits. Another machine tests valve tappets for hardness, sorts them for size, and discards those that are not passable. Scleroscope and electronic tube set-up are used. Piston pins are sorted into three sizes for selective assembly and into over and under-size compartments. Tests for hardness, straightness, and smoothness are included in the testing machine.

Precision in Spindles, by Leigh A. Banister & John Lawrence. (*The Machinist*, November 1, 1941, Vol. 85, No. 32, p. 693, 21 figs.)

Twenty-three operations now used to complete the spindle for a Fay automatic lathe are set up to take full advantage of modern tools and methods. Spindles are made from SAE 1045 steel, heat-treated to 200-235 Brinell before machining. The lot sizes have been increased to about 40 spindles. With the spindle completely turned and faced there follows a series of grinding, milling, turning, and drilling operations which are shown by drawings. Care is taken not to remove an excessive amount of stock in one operation, as it is necessary to reduce the possibility of distortion to a minimum. The grinding of the spindle threads in operation 21 has been highly successful in that it produces more accurate threads 47% faster than previous methods. In addition, the fact that the threads have a better quality finish makes assembly easier and more positive. The spindles are carefully inspected in operation 23. A routine check on diameters, shoulder lengths, tapers, etc., is made, and then the spindle is checked for run-out.

Generating Flat Surfaces, by E. V. Wait. (*Engineering*, November, 1941, Vol. 152, No. 3957, p. 381, 10 figs.)

Whitworth's three-plate method. In generating flat surfaces by matching three plates together in pairs it is necessary for the plates to match in more than one position. Various types of distortion. Two methods of attack: (1) A process could be chosen for removing the metal to obtain matching; (2) A system might be devised whereby the pairs of plates were checked in a sufficient number of positions. Method (1) is only applicable to lapping. Method (2) is applicable to both lapped plates and scraped plates.

Radiography Applied to Magnesium Alloy Castings, by P. M. Bailey. (*Met. Ind. (Lond.)*, October 10, 1941, Vol. 59, No. 15, p. 232.)

Equipment suitable for X-raying magnesium castings (films, filters, screens, viewing, lanterns, etc.); technique; types of defects detectable by this means.

(Communicated by the British Non-Ferrous Metals Research Association)

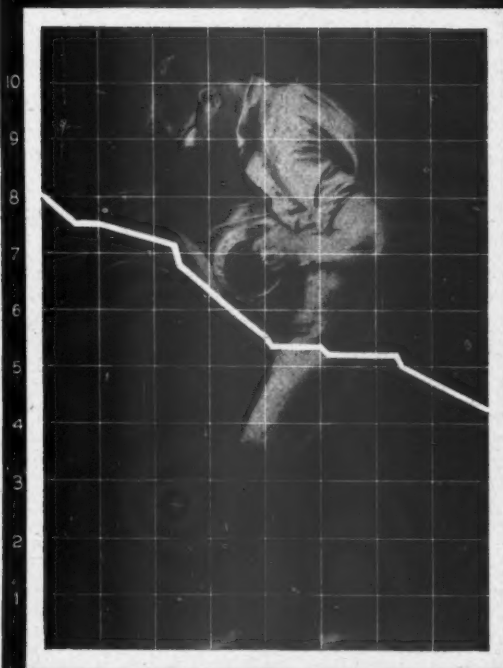
MECHANICS' MATHEMATICS.

Investigations on Shaft Fillets, by Paul Grodzinski. (*Engineering*, October 24, 1941, Vol. 152, No. 3954, p. 321, 18 figs.)

The equally distributed stress or normal stress S_n , usually assumed for stress calculations. The stress distribution around a radial fillet for a shaft under torsional stress. Photo-elastic investigations. The influence of the radius of the fillet for a shaft subjected to bending stress.

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The stress factor increases inversely with the fillet radius. Streamline fillets. Elliptical fillets. Endurance factor for shafts with streamline fillets. Torsional endurance tests on crankshafts with hollow pins. Taper fillets. Crankpin fillets.

PLASTIC MATERIALS.

Plastics Applied to Airplane Structure, by Charles F. Marschner. (*Mechanical Engineering, U.S.A., November, 1941, Vol. 63, No. 11, p. 787, 1 fig.*)

Research for the development of the use of plastics in production of aeroplanes is concerned with the properties of the plastic materials available and with the factors influencing production of these plastic materials. 22% of the empty weight of an aeroplane can be made of plastic material, including parts in primary and secondary structures. The materials must conform to the following requirements: (1) Mechanical properties satisfactory from a structural standpoint. (2) General chemical inertness. (3) No loss in properties throughout the range of atmospheric temperatures normally encountered, and preferably resistant to temperatures up to 300° F. (4) Low moisture absorption. (5) Ease of handling and molding in very large units with good resulting uniformity. An important factor is that plastics are used generally for mass production, whereas aeroplane parts are rarely required in numbers greater than 5,000. On the basis of technical considerations alone, which are not discussed in detail here, plastics can, and undoubtedly will, permit structural simplicity which will reflect itself in weight savings and reduced cost. There is good reason to believe that tooling up for molding will ultimately prove faster and less expensive than tooling up for sheet-metal fabrication. Tooling and fabrication difficulties may all be solved by conventional practices.

RESEARCH.

Power Losses in High-speed Journal Bearings, by F. C. Linn and D. E. Irons. (*Transactions of A.S.M.E., U.S.A., October, 1941, Vol. 63, No. 7, p. 617, 19 figs.*)

The effect and inter-relationship of the various factors which influence bearing losses have been the subject of many experiments and a vast amount of theoretical work since the basic physical principles of lubrication were outlined by Osborne Reynolds. In the half century following Reynolds' work the hydrodynamic theory of lubrication has undergone considerable development. Like all theory, it needs to be examined and re-examined in the light of experimental data. In this paper several novel contributions in the form of experiment and theory are presented. The paper deals with the results of tests made to determine the power losses of bearings of the type used on turbines manufactured by the company with which the authors are associated.

SHOP EQUIPMENT AND SHOP MANAGEMENT.

Present-day Machine and Plant Maintenance in the Small Works, by W. M. Halliday. (*The Factory Manager, November, 1941, Vol. IX, No. 11, p. 574.*)

Maintenance repair services are vital in every works. The large factory, with its full-time staff devoted to maintenance, is favourably placed compared with small works. Several easy means are discussed by which the small works can organise so as to reap similar trouble-free machine operation: Co-operation between tool-room and maintenance engineer.

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Co-operation between machine operators and maintenance fitter. Intelligent anticipation of breakdown. Provision of essential parts needed for repairs. Lubrication and transmission media. Three examples are given: The cross slide of an automatic lathe; a compressed air chuck for gripping workpieces; electric motors employed for direct drive to machines.

SMALL TOOLS.

Shank Size of Carbide Tools, by Paul H. Miller. (*The Machinist*, November 22, 1941, Vol. 85, No. 35, p. 775, 1 fig.)

From a study of field applications, and checked by calculations of actual loads imposed upon tools while cutting, nomograph has been constructed, so that the tool designer can select a suitable shank size for a given set of conditions. Three factors must be known: depth of cut and the feed, which determine the load on the tool; and the overhang, which determines the bending moment that the shank must resist.

Optimum Tip Thickness for Carbide Tools, by Paul H. Miller. (*The Machinist*, November 22, 1941, Vol. 85, No. 35, p. 773, 1 fig.)

Thickness of tips for carbide tools to be used on a given job cannot be calculated with absolute certainty. With the nomograph given it is possible to determine the safe tip thickness to be used for most tools. Thinner tips can be used for jobs where cutting stress is low, and an extremely tough job may require thicker tips.

Angles and Radii on Straight Form Tools. (*Machinery*, November 20, 1941, Vol. 59, No. 1519, p. 205, 6 figs.)

It is well known that form-turning tools do not produce surfaces having the same angles and radii as are present on the tool, because the necessary inclination of the tool in relation to the work causes a certain amount of profile distortion. This deformation is quite serious in the case of very accurate profiles, as, for instance, thread forms or profiles which are required to mate with others. In spite of the fact that these relations between the tool and work profiles are known, a general mathematical treatment of this problem seems to be lacking. In this article all derivations are made by plane trigonometry.

Titanium-Tungsten Carbide Cutting Tools: Methods of Analysis, by J. W. Jones. (*Chem. Age*, August 16, 1941, Vol. 45, No. 1155, p. 91.)

Practical details of a scheme for the chemical analysis of the tool tips. Literature references are given.

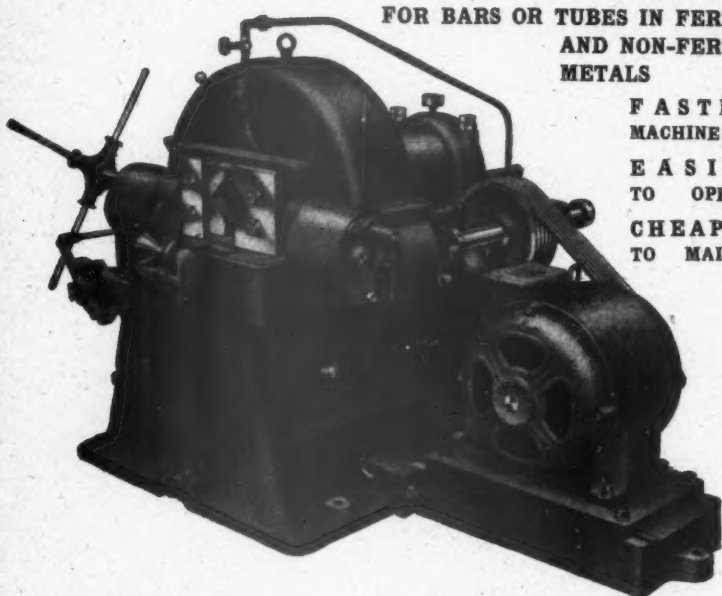
(Communicated by the British Non-Ferrous Metals Research Association)

Setting Diamonds in Wheel-dressing Tools. (*Machine Shop Magazine*, November, 1941, Vol. 2, No. 11, p. 58, 9 figs.)

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STANDARDISATION.

Reamers: Terminology and Definitions—I, II. (*The Machinist*, November 8, 1941, Vol. 85, No. 33, p. 723, 4 figs.)

Sponsored jointly by the Society of Automotive Engineers, the National Machine Tool Builders' Association, and the American Society of Mechanical Engineers, the new American Standard for Reamers (B5.14, 1941) was approved by the American Standards Association on June 2, 1941. Includes definitions of: (1) Reamers. (2) Lengths, measured parallel to the axis. (3) Size. (4) Chamfer. (5) Land. (6) Flute. (7) Shank. (8) Starting taper. (9) Pilot. (10) Guide. (11) Recess.

SURFACE, SURFACE TREATMENT.

The Surface Treatment of Metals by Diffusion, by I. Stewart. (*Mechanical World*, November 14, 1941, Vol. CX, No. 2863, p. 335, 3 figs.)

Modern methods of producing resistance to wear and corrosion. For many years cementation processes were almost entirely confined to ferrous materials, but with the recent intensive development of non-ferrous metals, particularly the aluminium and magnesium groups, the same conditions and requirements have become evident, and efforts have been made to apply the principles of diffusion to non-ferrous metals and alloys in order to modify their properties at the surface. The Aluminium Company of Canada make use of such a diffusion process for hardening the surface of aluminium products by heating them in finely divided magnesium to 250/460° C., that is, below the eutectic temperature of the binary system. As with most diffusion processes, the depth of penetration is controlled by time and temperature of the heating cycle, and magnesium oxide is added to the powdered metal as a diluting medium. Table I indicates the hardness increases that can be effected.

TABLE I. HARDNESS OF ALUMINIUM WITH DIFFUSED COATING OF MAGNESIUM.

Material.	Impregnation. Temp. °C.	Impregnation. Time. Hours.	Brinell Hardness.	Vickers Hardness.
Pure Aluminium	—	...	14.4	12.1
	445	39	43.0	—
	437	24	41.4	—
	445	62	27.0	87.2
Aluminium with Magnesium...	445	109	31.1	—
	450	61	26.6	40.6
	449	67	27.4	—
	450	50	—	56.7

Not only have metals and alloys been diffused into the surface layers of aluminium, but aluminium itself has been used protectively to coat ferrous articles. Silicon, the compound Cu₃Si, and beryllium can be diffused into copper. Chromium impregnation, or chromising, is a process devised to produce a high chromium iron layer on the surface of low carbon steel or iron articles, and, although of limited application, it has proved extremely satisfactory under conditions where acid corrosion is experienced.

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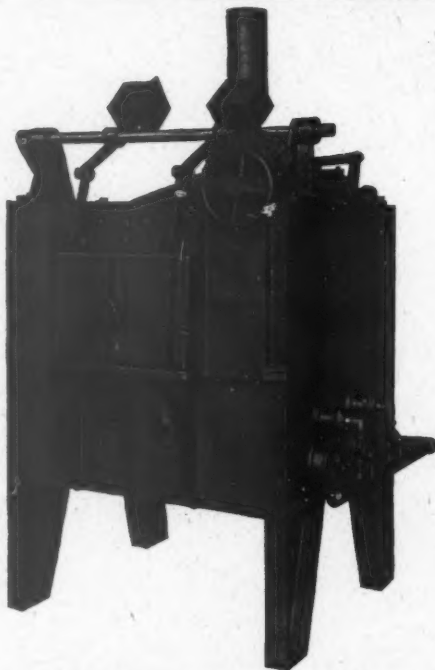


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PRODUCTION ENGINEERING ABSTRACTS

Journal Roughness Improves Bearing Life. (*Iron Age*, August 7, 1941, Vol. 148, No. 6, p. 57.)

An American automobile manufacturer pretends to have found from tests with endurance runs that bearing life is improved if crankshaft journals are finished with a surface roughness 40-70 micro-in. (depth of depressions measured on profilometer), instead of the more customary 4-5 micro-in.

(Communicated by the British Non-Ferrous Metals Research Association)

Surface Contour by Taper Sectioning, by H. R. Nelson. (*The Machinist*, November 15, 1941, Vol. 85, No. 34, p. 743, 13 figs.)

Taper sectioning provides a useful means of studying the surface contour of metals. It is not an inspection method, because it destroys the surface examined; neither will it replace the much more rapid tracer-point methods. In practice it is necessary to support the surface to be sectioned with an adherent coating which will prevent smearing the contour during the sectioning operation. For steel surfaces a nickel plate about 0.025 in. thick is satisfactory.

Following the grinding operation, the specimens are polished by hand on successively finer grades of abrasive paper, and are given a final metallographic polish without etching. In order to give contrast, the specimen is lightly heat-tinted, which darkens the steel but leaves the nickel bright. Scratch depths less than about 10 micro-inches cannot be measured with certainty by the technique described herein.

WELDING, BRAZING, SOLDERING.

Practical Arc Welding of Tubular Structures, by Francis H. Stevenson. (*The Welding Industry*, November, 1941, Vol. IX, No. 10, p. 242, 10 figs.)

Jig for welding motor mounts. Spring in jig aids in control of expansion and contraction. Fitting, using a plate and straps and procedure for welding the piece. Ring tacked ready for welding. Jig for welding ring forgings to ring and procedure for welding. Procedure for welding in gussets.

Spot-welding of Light Alloys. (*Junkers Journal (Germany)*, Vol. 12, Nos. 5 and 6, May and June, 1941, p. 59/69.)

Spot-welding of light alloy sheets has been successful, provided proper attention is paid to the preliminary treatment of the sheet, and that the welding current and electrode pressures are suitable. Pure Al-Mg and Al-Si-Mg alloys are relatively easy to spot weld, although in the latter case the heat-treated material will lose some of its strength in the weld zone. Al-Cu-Mg alloy sheet require the greatest care in the control of the current characteristics. Loss of strength due to softening can be made good by a closer spacing of the spots.

A thorough cleaning of the sheets prior to welding is essential. This can be carried out either by immersion in a caustic soda bath or by mechanical brushing. As already mentioned, control of the welding current is of the utmost importance. Experiments were carried out with different types of current pulses and rest periods. An alteration of the wave form during the welding process was found to be beneficial.

Thus, for example, a successful current control adopted consisted of five periods at maximum amplitude alternating with five periods at 50% amplitudes, with rest periods (zero current) of five periods between the changes 1 period = 1/50 sec. In this case there are two pulses



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per spot weld. Alternatively, single pulse control can be adopted, the current rising to a maximum during five periods, and then diminishing to zero over the next five periods. No details of the electronic controls are given. By proper timing of its pulses it is apparently possible to work four or more machines from a single 350 K.V.A. transformer, leading to a considerable saving in the cost of the plant. Types of electrode employed are described in some detail. Electrolytic copper appears to be the most suitable material. Means for rapid cleaning of the electrodes are essential. Interposition of a thin foil of brass between electrode and weld has been found very beneficial in this connection. The foil (in ribbon form) is moved automatically, and carries away most of the impurities, which would otherwise accumulate on the electrode.

(Communicated by the D.S.I.R., Ministry of Aircraft Production.)

Lead-welding Technique in Chemical Works—I, by A. Eyles. (*The Machinist*, November 15, 1941, Vol. 85, No. 34, p. 262E.)

The fusion welding of lead is customarily known as lead-burning. This term, however, is incorrect, as the operation produces a true fusion weld. In lead welding there is little or no variation between the coefficients of expansion of the weld metal and the base metal. The several systems of lead-burning include oxy-acetylene, oxy-hydrogen, oxy-coal-gas, air-acetylene, air-hydrogen, and oxy-butane, but the oxy-acetylene system is faster than the others. Success largely depends on thorough preparation, clean surfaces, suitable gases and equipment, proper materials, and skill of the operator. Sheet lead seams and pipe joints must be scrupulously clean. Fluxes are not required. Immediately before the welding operation the areas to be welded and the edges to be joined should be well scraped (preferably with a steel shavehook), leaving a bright surface. For sheet lead weighing 5lb. per square foot, which is generally known as 5lb. sheet lead (0.085in. thick), the finished joint or seam should be approximately $\frac{1}{4}$ in. wide, i.e., the edge of each sheet should be scraped bright to a width of $\frac{1}{4}$ in., and for 8lb. sheet lead (0.135in. thick) the completed joint should be about $\frac{1}{2}$ in. wide. For butt joints, with plate lead more than 12lb. per foot super., the edges are usually bevelled at 45°, to form a right angle at the weld joint. The welding flame can then come into direct contact with the whole surface to be joined, that is, the fusion of the edges in butt joints should penetrate the full thickness of the lead. It is bad practice to allow molten metal to flow through joints and project below the undersurface of the plate or sheet. It is always advisable to use a thin lead strip or rod when fusing the two edges of butt joints together, as it can fill any small cavity which may be formed in the process. The blowpipe should be held so that the flame is practically perpendicular to the surface of the leadwork. The heating can then be localized and more easily controlled.

Aircraft Spot-welding Problems (Digest). (M. M. Rockwell, J.S.A.E., (U.S.A.), Vol. 49, No. 4, October, 1941, p. 441.)

Aluminium alloys have low electrical resistance and high heat conductivity, hence very heavy welding currents and pressures must be used. Even then most of the generation of heat occurs at the surface of contact between the sheets being welded.

These conditions have imposed difficulties which have somewhat retarded the application of spot-welding in the aircraft industry. However, of recent years development has come very rapidly.

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The increase in requirements for spot-welding equipment in turn brought to the fore a very serious problem, the magnitude of the power supply necessary for such equipment.

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Consistent maintenance of the proper pressure is essential to successful spot-welding, because pressure controls the surface contact resistance. In many machines pneumatic force is used to produce electrode pressure, and, if the air lines to the welder are too small, the air pressure will drop when the machines are operated rapidly, and mysterious troubles will ensue. It was found necessary to install a large air receiver near the welders to overcome this trouble. Hydraulic pressure systems should be a helpful improvement.

Probably the greatest single cause of spot-welding trouble is improper surface preparation. Oil, grease, or paint left on the surfaces to be welded produce cracked, burned, weak, or even "blown" spots. Careful cleaning is essential, and in most cases it is also necessary to remove part of the oxide film which always covers the surface of aluminium alloys.

(Communicated by the D.S.I.R., Ministry of Aircraft Production.)

Recommendations for Oxy-acetylene Butt Welds in Mild Steel Pressure Pipe Lines. (*Quarterly Transactions of Inst. of Welding, October, 1941, Vol. 4, No. 4, p. 176, 11 figs.*)

Scope. Parent metal. Filler metal. Welding technique. Preparation of pipe ends. Characteristics of butt welds. Supervision and workmanship. Heat treatment. Tests on butt welds. Pressure tests on pipe lines.

WORKS AND PLANT.

From Motor-cars to Machine-guns. (*The Machinist, November 1, 1941, Vol. 85, No. 32, p. 703, 27 figs.*)

The method of conversion of American factories from peace-time production to the production of armaments is outlined. Emphasis is laid upon the importance of abandoning some of the slow methods of production of armaments used for small quantities in peace-time and replacing these by less conventional methods adapted to mass production.

Planning Lay-out of Plants, by Harry Wilkin Perry. (*Aircraft Production, December, 1941, Vol. IV, No. 38, p. 103, 6 figs.*)

Large-scale orders have at last enabled the aircraft industry to adopt line-assembly, quantity production methods that made automobile manufacturing the third largest American industry. An excellent example of what has been accomplished along these lines by the foremost companies in the United States in the last twelve months is afforded by the Douglas Aircraft Co. While extensive additions were being made to the Santa Monica and El Segundo factories in California and a large new plant was being built at Long Beach, plans for reorganising shop and assembly departments on a progressive, direct-flow basis were developed in a new plant lay-out department set up for the purpose at the Santa Monica plant.

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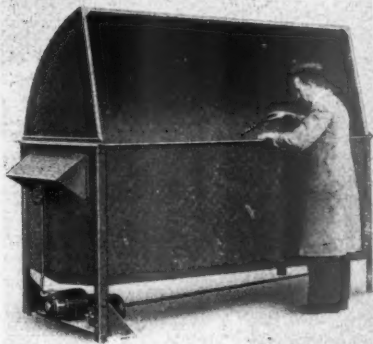
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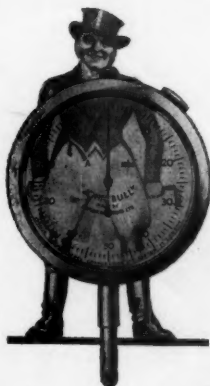


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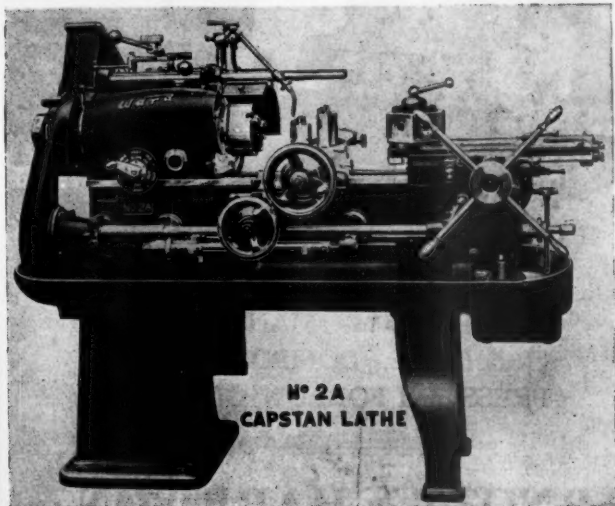
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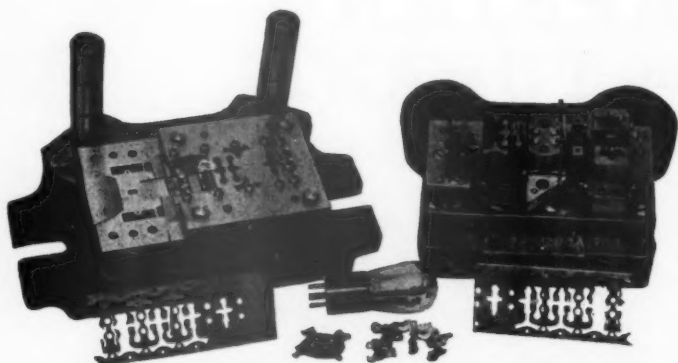
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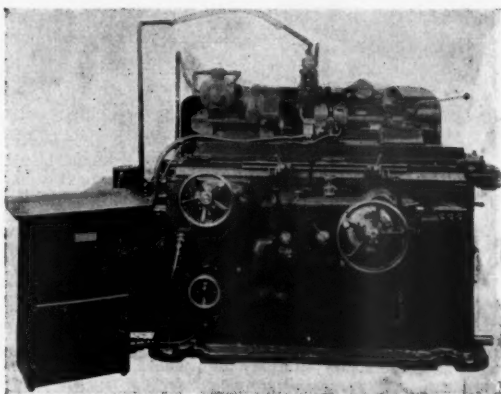
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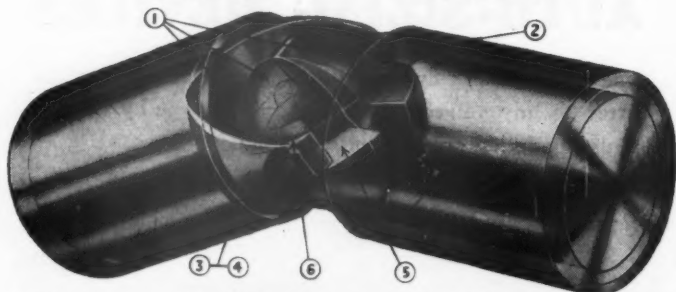
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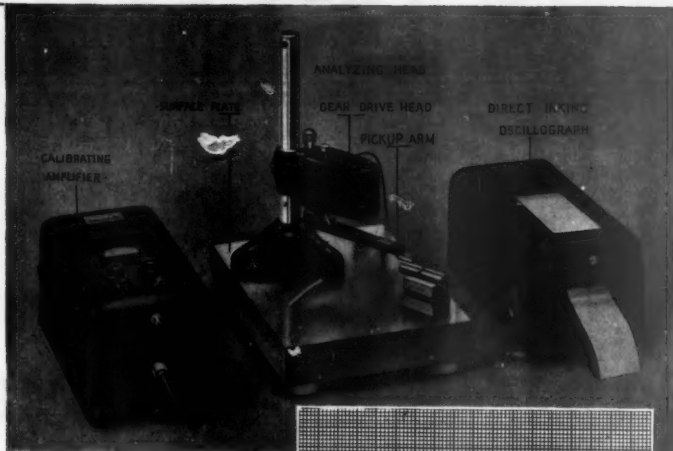
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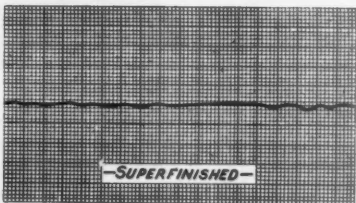
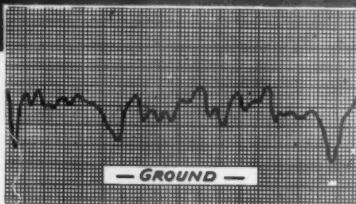
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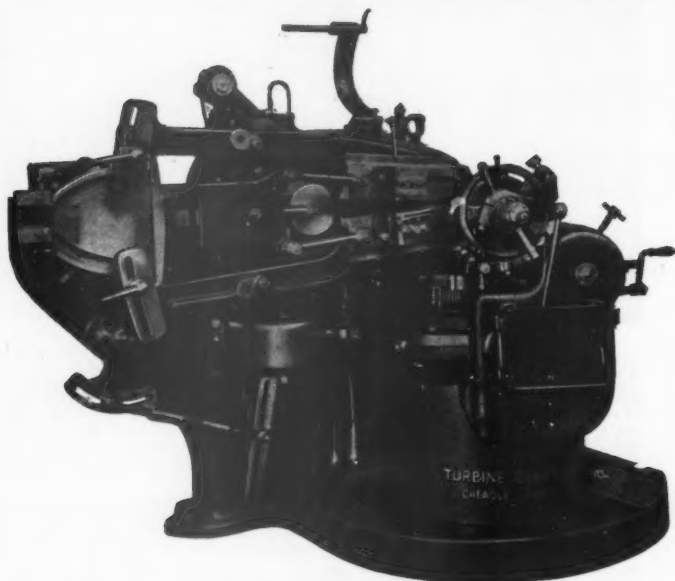


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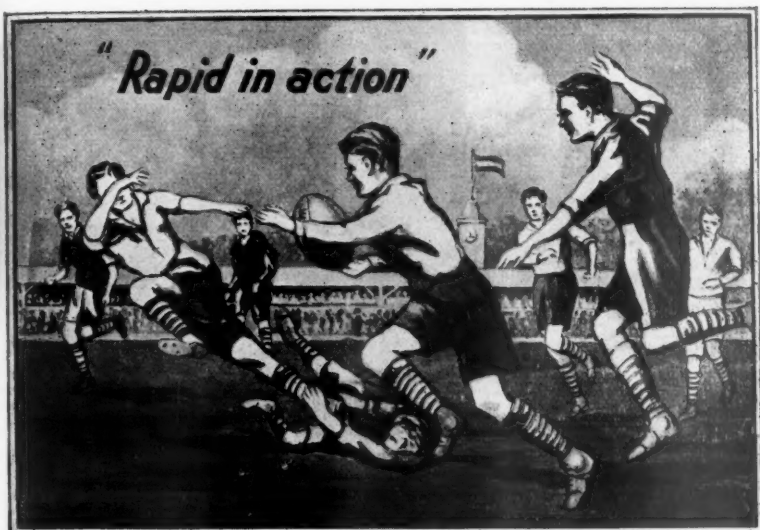
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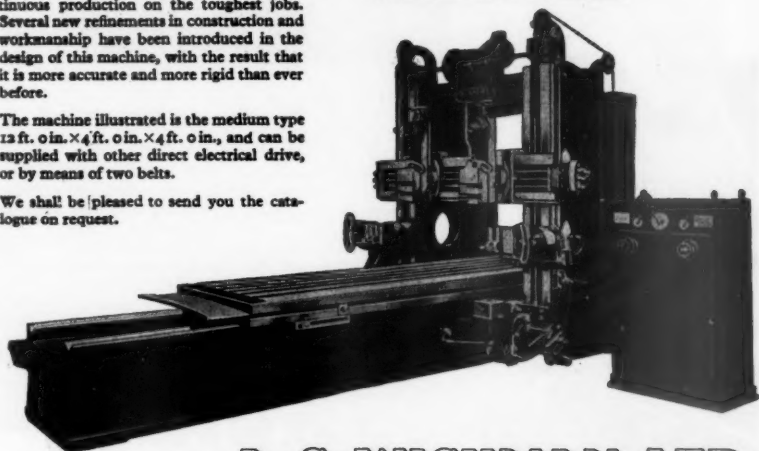


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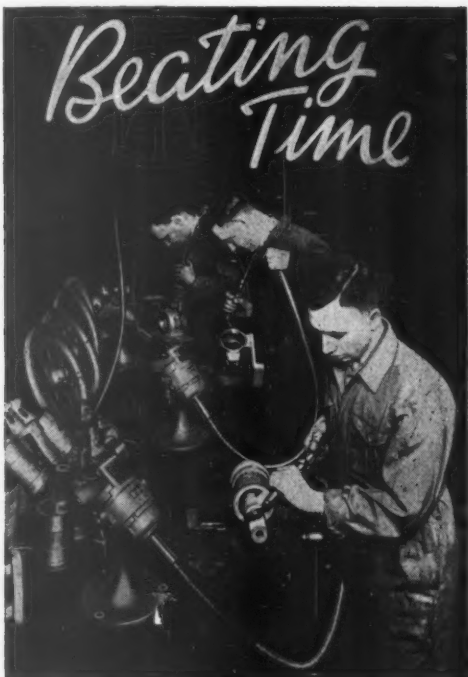
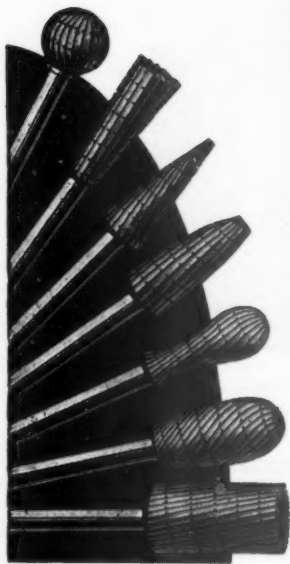
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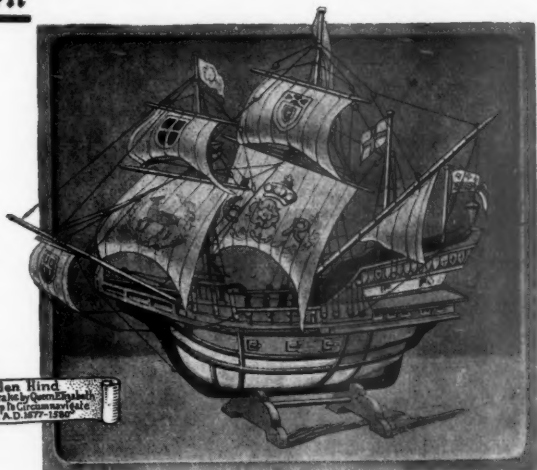


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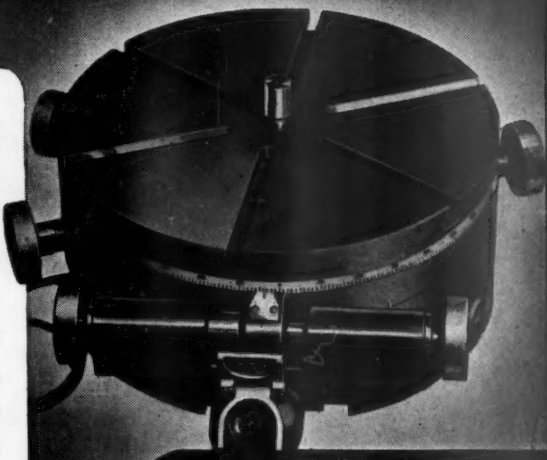
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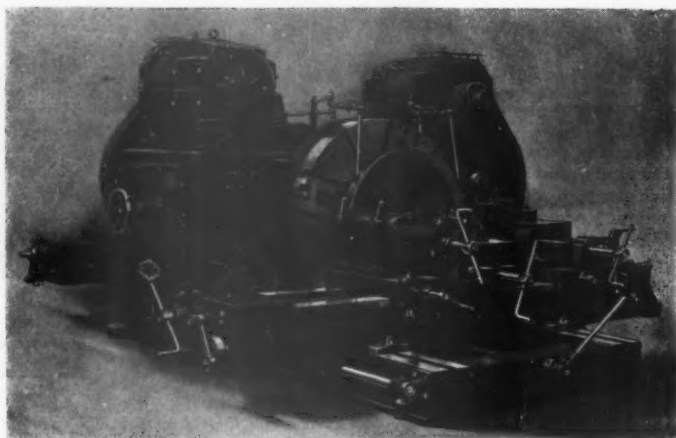
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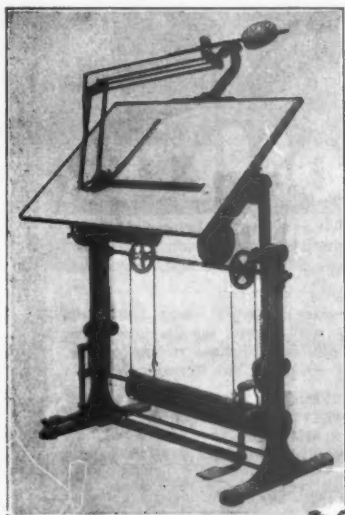
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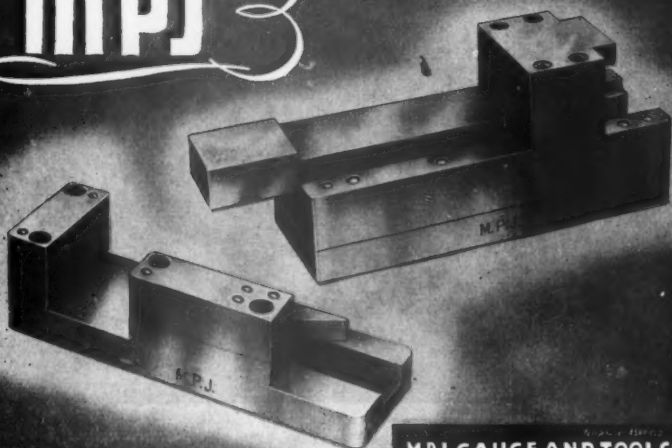
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ULTIMATE STRESS IN TENSION tons per sq. in.	7-8	16-18	20-23
0.1% PROOF STRESS IN TENSION tons per sq. in.	4-5	10-13	17-19
ELONGATION % on 2 in. gauge length	27-30	22-18	14-10
BRINEL HARDNESS NUMBER	20-28	65-80	90-120

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Spel
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Therm
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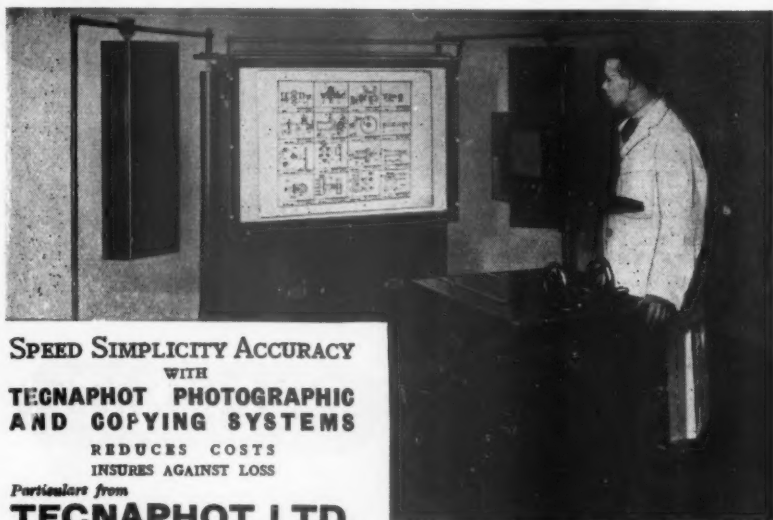
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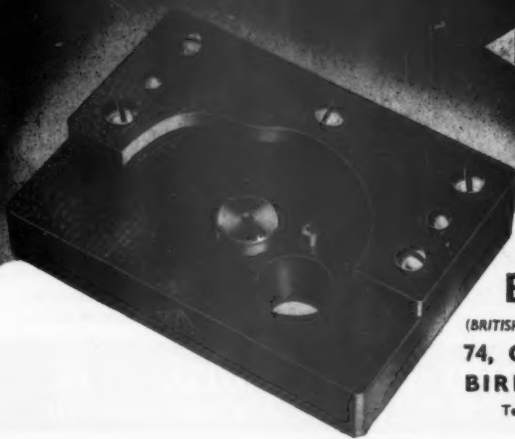
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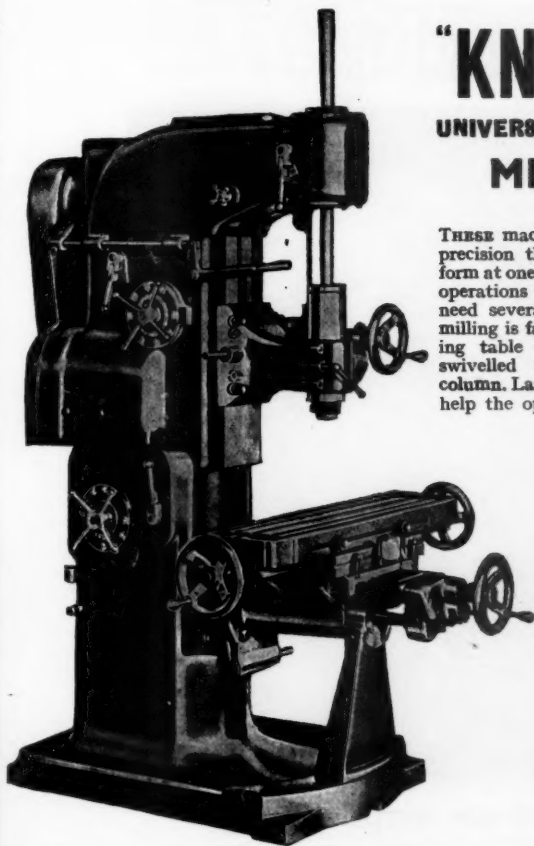
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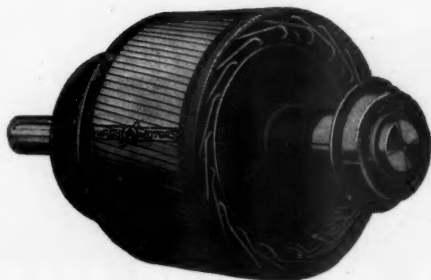
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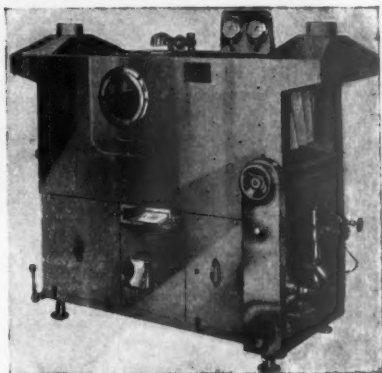
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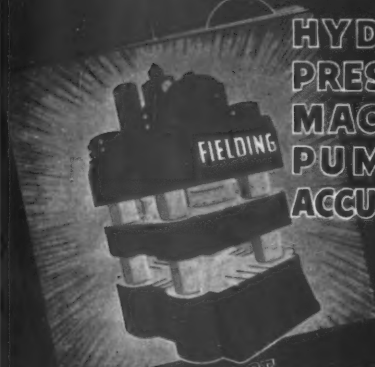
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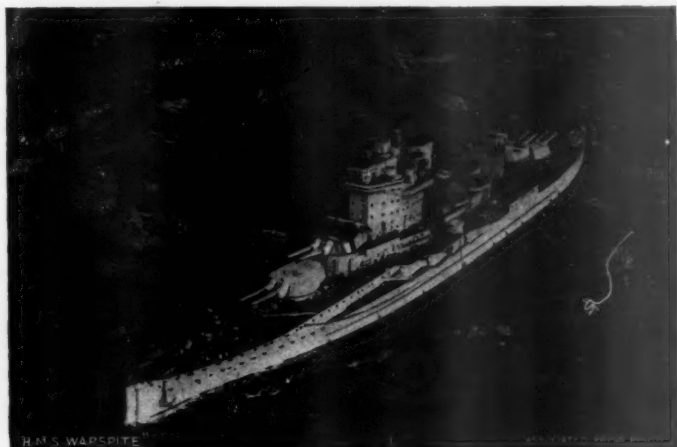


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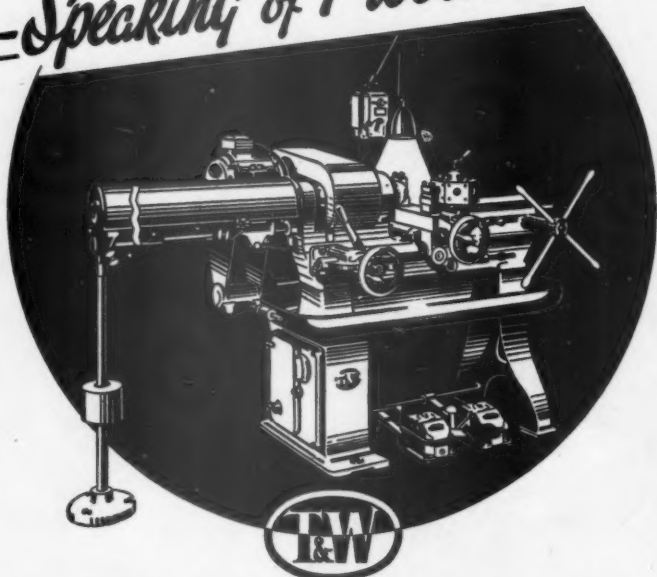
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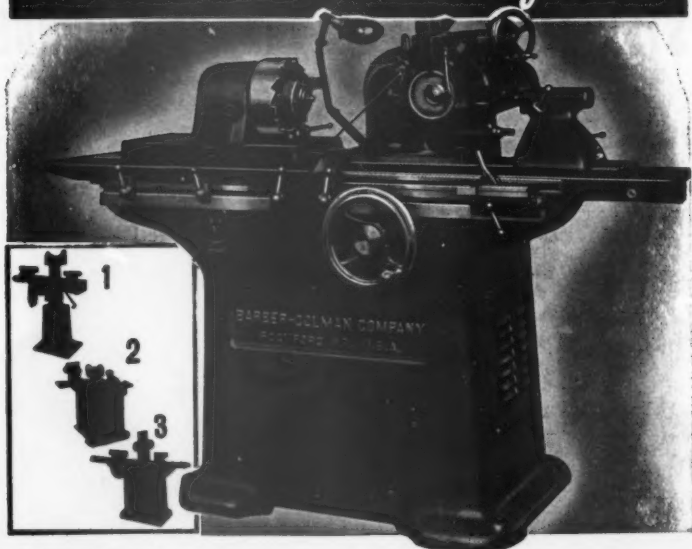
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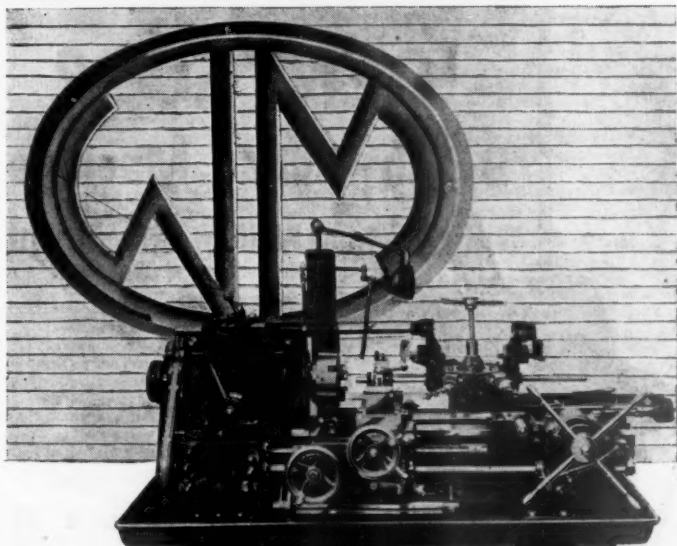
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